THE EFFECT OF THE NEIGHBOURHOOD BUILT ENVIRONMENT ON OBESITY IN CHRISTCHURCH

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Abstract

Obesity is becoming a worldwide concern, with more than 300 million individuals who are obese and a further 750 million who are overweight. This increase is important as obesity has been linked to an increased incidence of cardiovascular disease, type two diabetes mellitus, stroke and some cancers.

One factor receiving increasing attention to explain variation in obesity prevalence is the role of the built environment. This involves examining how features of the built environment such as green space or food premises vary by neighbourhood area. The presence of such resources within a neighbourhood can influence obesity through encouraging a healthy or unhealthy environment. It is important to understand how neighbourhoods influence obesity. This will allow the creation of effective public policy and urban design initiatives to reduce the obesity prevalence.

Little research has examined how the quality of these resources varies between neighbourhoods and their effect on the prevalence of obesity. This thesis addresses this using a systematic site survey tool to investigate how the quality of built environment resources varies by neighbourhood deprivation. It also employs a questionnaire to examine residents' perception of their neighbourhood as these can influence obesity through the utilisation of healthy resources.

Three key findings were identified: there is a significant relationship between deprivation and the number of neighbourhood resources; the quality of these resources increases as deprivation increases; and residents in a high deprivation neighbourhood had a more positive perception of the neighbourhood. As a result, high deprivation neighbourhoods may be less likely to promote obesity as they have higher quality resources and residents have a more positive perception of the environment.

These findings suggest that the influence of the built environment is context specific and that it may not be as influential on obesity in Christchurch. It highlights the need to consider both individual and environmental factors in explaining the geographic variation of obesity.

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List of Abbreviations

BMI	Body Mass Index
CBD	Central Business District
MOH	Ministry of Health
NIMBY	Not In My Back Yard!
NZDEP06	New Zealand Index of Deprivation 2006
PWC	Population Weighted Centroid
RMA	Resource Management Act
SHORE	Centre for Social and Health Outcomes Research and Evaluation
WHO	World Health Organisation

Chapter One
Introduction and Thesis Aims

1.1 The Obesity Dilemma

The prevalence of overweight and obese populations worldwide has increased sharply in recent decades, nearing epidemic proportions in some countries. In 2004, the World Health Organization (WHO) estimated that more than 300 million people worldwide are obese (WHO 2003), which is a significant increase of more than 100 million people since 1995. In addition, more than 750 million individuals are overweight (Mhurchu et al. 2005). It is predicted that in the United States rates of obesity within 20 years could reach 45-50%. Similarly, in Australia and England, rates could reach 30-40% (Duncan et al. 2004). In New Zealand, the 2002/03 *New Zealand Health Survey* conducted by the Ministry of Health (MOH) reported that one in five New Zealand adults are obese, and that the prevalence of obesity has increased from 11% to 21% between 1989 and 2002 (MOH 2006a). It has been estimated that this figure will reach 29% by 2011 (MOH 2002).

Obesity results from a positive energy balance over time, when total energy intake, through food and/or drink, exceeds total energy expenditure by physical activity (Kim et al 2006). Levels of excess weight contribute substantially to the burden of disease. Both obesity and overweight are associated with an increased incidence of cardiovascular disease, type 2 diabetes mellitus, hypertension, stroke and osteoarthritis (Must et al. 1999). Excess weight has also been identified as a risk factor for some cancers, including endometrial, breast, prostate and colon cancer (Anderson 2003).

The WHO has estimated that the cost of obesity for a country is between two and seven percent of the annual health budget (WHO 2000). Table 1.1 outlines the annual direct and indirect medical costs associated with obesity. This includes the costs of running hospitals, general practitioner and specialist services as well as other financial costs such as productivity losses, premature mortality and government programs designed to address obesity.

The table shows that as the rates of obesity increase in a country, the annual costs of obesity increase. For example, in 2006 Australia had a population of approximately 20 million people and an obesity rate of 32.6% (Australian Bureau of Statistics 2006). This is compared to Canada which despite having a population of approximately 30 million, a rate of only 23.1% results in a lower annual cost of obesity than Australia (Health Canada 2004). This highlights the existence of inequalities in obesity prevalence between countries.

Country	Annual Cost of Obesity	Year Estimated	Published by
United States	$117 billion	2000	US Department of Health and Human Services
United Kingdom	£3.3-£3.7 billion	2004	House of Commons Health Committee
Australia	$3.76 billion	2006	Access Economics
Canada	$2 billion	1999	Birmingham et al.
New Zealand	$303 million	2003a	Ministry of Health

Table 1.1: The direct and indirect medical costs of obesity

1.2 Inequalities in Health and Obesity

Health inequality is a generic term used to designate differences, variations and disparities in the health achievements of individuals and groups (Kawachi et al. 2002).

If a disease is randomly or equally distributed within a group then there is no health inequality within that population. Research has shown that the prospect of death at most ages is strongly related to a measure of social and economic position, (Bartley 2004) and that the presence of health inequalities makes a major contribution to avoidable mortality and ill health (Dowler and Spencer 2007). It is well known that good health is not evenly shared. For example, according to the UK Independent Inquiry into Inequalities in Health, if all men aged 20–64 had the same mortality rates as those in the top two social classes, there would be approximately 17 000 fewer deaths each year in that country (Acheson 1998).

There is a long history of measurement of health inequalities throughout the developed world, and this has always recognised the contribution made by the social circumstances of individuals to health inequalities in society (Boyle et al. 2004). Avoidable inequalities in health experience and outcomes related to socioeconomic status, ethnicity and gender have been identified at all stages of the life course from pregnancy to old age (Dowler and Spencer 2007) Particular attention has been given to the influence of individual socioeconomic status to explain the variation of health outcomes within a population. Compared to individuals higher up in the social hierarchy, those further down are more likely to succumb to disease and premature death (Benzeval et al. 1996).

Explanations for inequalities in the prevalence of obesity have also followed this pattern. Past research has stated that individuals of lower socioeconomic status and of certain ethnicity are more likely to be obese than their affluent, predominantly white counterparts (Ellaway and Macintyre 1996, Duncan et al. 2004, Dollman et al. 2005,

Bodea et al. 2009). As a result, national strategies developed to improve the health of populations have focused on the role of individual lifestyles. A critique of this approach is that individual level factors explain a relatively small proportion of the health inequalities between different groups. (Williams 2007). An over-emphasis on the role of individual health behaviours has tended to ignore the influence of the complex social and physical context in which individual behavioural decisions are made

Social inequalities in health are also matched by inequalities between places. Places cannot be ignored in social policy because they both concentrate deprivation (and affluence) and have real attributes that affect health and other outcomes (Blackman 2006). The strong relationship between deprivation and poor health combines with the spatial sorting of local housing markets to create a graded geography of more and less healthy places where those with the fewest material resources tend to be sorted into the unhealthiest neighbourhoods. For example, Britton (1990; cited in Macintyre et al. 1997) notes that for the last 150 years mortality rates have been highest in the North and West United Kingdom; in highly urbanised areas; and in areas with high concentrations of households characterised as materially and socially deprived. As poor health tends to cluster geographically, neighbourhoods are seen as part of the solution to tackling health inequalities.

The prevalence and spatial distribution of obesity is very unequal. In some developing countries obesity is occurring faster than more developed nations (WHO 2002). Statistics show the many Pacific Island countries have the highest levels of obesity throughout the world. The WHO *Global Body Mass Index* found that of the top ten most obese countries, eight of these are Pacific Island nations (WHO 2005). The lowest

levels of obesity occur in many of the Asian countries, including Japan, Vietnam and Cambodia who have a prevalence of less than 1.6% (WHO 2005).

The recent WHO *Global Burden of Disease* report estimated that obesity rates can vary regionally from 2-3% in some Asian countries, to 75% in several Pacific Island nations, indicating that inequalities can exist not only between, but also within countries (James et al. 2004). For example, in the United States, the prevalence of obesity increased by 102% in Georgia, but by only 11% in Delaware between 1991 and 1998 (Mokdad et al. 1999). Similarly, while 30% of men and 37% of women in Mississippi were medically obese in 2000, only 18% of men and 24% of women were medically obese in Colorado (Ezzati et al. 2006). Research has suggested that city wide obesity variation is also possible. Data from the 1998 *American National Health Interview Survey* found that men and women living in central cities were more likely to be obese than those living in suburban environments (Lopez and Hynes 2006).

1.3 The Importance of Examining Geographic Variation in Obesity

It is important to understand the explanation for the increasing prevalence of obesity in New Zealand so strategies can be developed to effectively address the situation. Various explanations have been proposed for the observed geographic variation in obesity, particularly the contribution of compositional and contextual effects. Considerable attention has been attributed to whether variations in obesity reflects the composition of individuals in different areas (the composition argument), or a result of the physical and social context in which people live (the contextual argument). Numerous individual level factors may affect the geographic variation in obesity including individual socioeconomic status, ethnicity, gender and age. Conversely,

contextual factors that could influence geographic variation in health outcomes include the provision of resources and socioeconomic status of an area.

It is often assumed that variation in compositional factors is the driving force behind the spatial variation of obesity. However, a number of researchers have considered questions related to the effects of area deprivation over and above individual socioeconomic characteristics and have reported what is termed a residual 'area effect' (for example Shouls et al. 1996, Wiggins et al. 1998). This suggests that the cause and variation of obesity is not just a product of the sum of individuals living in a certain areas, but is also to some extent determined by the environment in which they live (Macintyre et al. 2002, Lake and Townshend 2006, Lopez and Hynes 2006, Harrington and Elliot 2009, Santana et al. 2009). For this reason, the study of the variation in environments and their influence on obesity is necessary.

1.4 Rationale: The Gap in the Literature

There is growing recognition that the neighborhood in which one lives has important implications for the health and well-being of families and children. Understanding the links between populations, health, and place is of key importance because preventive action or intervention at the area-level can have far-reaching benefits for community health outcomes and can modify the health status of large groups of people. Two significant gaps exist in the literature examining the influence of the built environment on obesity.

The first of these is the lack of understanding of how the quality of built environment resources varies by neighbourhood and the influence this may have on obesity. Past

research examining the role of the built environment and neighbourhoods in influencing obesity can be classified as one of two categories. The first of these has focused on how differences in macro-scale urban design features influences obesity. This has included examining how neighbourhood characteristics such as urban sprawl (Ewing et al. 2006, Kelly-Schwartz et al. 2004), road connectivity and transport mode (Frank et al. 2004, Wen et al. 2006, Frank et al. 2007, Samimi et al. 2009) and the walkability of the environment influences obesity (Ewing et al. 2003, Berke et al. 2007, Frank et al. 2007, Scott et al. 2009, Sallis et al. 2009), and how variations in these characteristics may encourage or discourage obesity prevalence. The second path has focused on the influence of neighbourhood deprivation and access to material resources required to maintain a healthy lifestyle. This has included the influence of deprivation on access to food resources (French et al. 2000, Frank et al. 2009, Morland and Evenson 2009) and green space or areas for physical activity (Giles-Corti et al. 2003, Mobley et al. 2006, Stafford et al. 2007).

Numerous international studies have found that neighbourhood deprivation influences both the urban design of a neighbourhood, and access to material resources (Kennedy et al. 1998, Gordon-Larsen et al. 2006, Cummins and Macintyre 2006, Seliske et al. 2009). Few however, have incorporated a direct measurement of neighbourhood conditions with the assumption being that as resource access decreases by deprivation, resource quality will also decrease. Resource quality studies are important to advance understanding of the qualitative nuances of neighborhood circumstances that shape individual's daily experiences and ultimately the context for health. The few international studies that have examined the condition of neighbourhood resources have

found that as neighbourhood deprivation increases, the quality of resources decreases. (Macintyre et al. 1993, Lee et al. 2005, Coen and Ross 2006).

This thesis intends to address this research gap by examining the influence of deprivation on the quality of resources within a New Zealand context. This is particularly important as findings from research examining access to material resources by deprivation have generally been inconsistent with international literature (Field et al. 2004, Pearce et al. 2007a, Pearce et al. 2007b, Pearce et al. 2008a). As a result, the relationship between resource quality, obesity and neighbourhood deprivation may contrast the suggested relationships from the international literature.

A second gap in the built environment literature is the role of environmental perception. The perception of the surrounding neighbourhood environment by neighbourhood residents is an important influence on obesity as positive or negative perceptions can impact on the utilisation of resources by neighbourhood residents. Research has shown that in neighbourhoods where perceived access to supportive walkable environments and green space is greater, the likelihood of being obese is up to 5% less (Nelson and Woods 2009). This is based on the idea that the greater the perception that a resource is available, the more likely neighbourhood residents are to utilise that resource.

Studies have shown that neighbourhood deprivation influences individual perception as those living in low socioeconomic areas less likely to maintain positive perceptions of their neighbourhood environment (Ellaway et al. 2001, Giles-Corti and Donovan 2002). However, to date, only one known study has examined the difference between neighbourhood perceptions of the environment and actual available resources and its

influence on physical activity. As a result, little is known about how residents' perceptions of their environment and the resources available could influence the likelihood of obesity within these neighbourhoods.

This thesis intends to examine how residents' perception of the environment varies as a result of neighbourhood deprivation. It aims to examine whether the perception of available resources varies compared to actual neighbourhood resources and how resource utilisation is affected by this. Understanding how individuals perceive their neighbourhood plays an important role in encouraging the utilisation of healthy resources.

This thesis builds on current research in New Zealand examining the role of deprivation on the built environment and seeks to provide evidence that neighbourhood context has an important role in influencing obesity prevalence.

1.5 Research Aims

The overall aim of this thesis is to examine how neighbourhood deprivation influences the likelihood of an obesogenic environment. The objectives of this thesis are:

1. To examine whether neighbourhood deprivation influences the availability and quality of built environment resources.

2. To investigate how residents' perceptions of food resources, green space and crime and safety vary by deprivation and how this may influence consumption and physical activity levels.

1.6 Thesis Structure

In order to achieve these objectives the thesis is organised as follows:

Chapter Two provides an overview and critical review of the influence of the built environment on obesity. It outlines the principal causes of obesity and explains why understanding the influence of the environment is important in obesity variation. The compositional versus contextual debate is introduced and individual and environmental characteristics which could account for the different prevalence rates of obesity observed within New Zealand are outlined. Most importantly this includes the introduction of the six main built environment features influencing obesity that are examined in this thesis. The final section of this chapter outlines alternative reasons that could count for geographic variations in obesity.

Chapter Three outlines the methods adopted to achieve the two research objectives. The forms of analysis used in this thesis will be explained using both qualitative and quantitative methodologies.

Chapter Four introduces the nine neighbourhoods examined in this thesis. It discusses the characteristics of each environment as well as the differences in resource variation and provision in the neighbourhoods. This chapter also presents the social characteristics of the participants involved in the questionnaire process and how these vary by area deprivation.

Chapter Five presents the results of the first objective of this thesis investigating the quality of available neighbourhood resources. The results of the site survey tool used to examine the quality of resources of each individual neighbourhood are presented. The

results of the objective measures used to test the validity of the site survey tool are also outlined.

The aim of Chapter Six is to present the different perceptions of individuals surrounding neighbourhood environments as a way to ascertain how local perceptions can shape the utilisation of obesity influencing resources

Chapter Seven highlights the key findings and situates them within the wider body of national and international literature. Limitations of the study are noted and potential implications from the research are discussed.

Finally Chapter Eight presents the conclusions related to the aims of this thesis. Future research avenues are identified which would further the findings of this research.

1.7 Conclusion

This chapter has introduced the thesis within the context of the current obesity epidemic and has justified why examining the role of the built environment in explaining obesity variation is important. The cause of geographic inequalities in obesity has been the subject of significant debate, and it is only recently that the role of the neighbourhood in influencing the quality and access to resources has received attention. The lack of obesity research conducted in New Zealand means that many gaps still exist in understanding the role neighbourhoods have in encouraging or reducing obesity. It is anticipated that in examining the quality of resources and perceptions of neighbourhood residents this thesis will extend the understanding of the importance of neighbourhood design in influencing obesity prevalence.

Chapter Two
Theoretical Framework

2.1 Introduction

The aim of this chapter is to examine the literature on the relationship between the built environment and health and obesity. First, an overview and definition of obesity is provided. The influence of physical activity and dietary behaviour on health and obesity variation is also examined as these are behaviours that can modify the prevalence of obesity in a neighbourhood. Second, the reader is introduced to arguments on the importance of place when examining health outcomes, including an introduction to the composition versus context argument. Thirdly, in order to understand the contextual influence on obesity, the relationship between the built environment and obesity is reviewed laying out the current understandings of the link between neighbourhood variation and obesity. This section looks at six built environment influences: urban sprawl, transport mode/road connectivity/walkability, mixed land use, food environments, green space and physical activity and crime. Finally, explanations are provided as to why differences in the quality and access to resources may exist between neighbourhoods of the same and differing deprivation.

2.2 Overview of Obesity, Physical Activity and Nutrition

The principal cause of obesity is an imbalance between energy intake and expenditure (Ellaway et al. 2005). It is defined as an excessively high amount of body fat or adipose tissue in relation to lean body mass (Stunkard and Wadden 1993), and is most commonly measured using an arbitrary threshold of the body mass index (BMI)

(Ministry of Health 2006b) calculated by using an individual's weight and dividing by their height in metres squared (Duncan et al. 2004). Although more accurate techniques are available for estimating the extent of body fatness, BMI remains the most cost-effective and practical tool. In 1998, the WHO provided international BMI standards for classifying overweight and obesity in adults based on the risk of obesity-related disease for Europeans at each BMI category (WHO 1998). Overweight is defined as a BMI between 25kg/m^2 to 30kg/m^2 and obesity as a BMI greater than 30kg/m^2 (Frank et al. 2004). An obvious limitation of this measure is its inability to distinguish between fat and fat-free mass such as muscle (Duncan et al. 2004). As a result, standard BMI cut-offs based on the European classification for overweight and obesity may not accurately represent the levels of body fatness in individuals of other ethnicities.

An individual's dietary and physical activity behaviour is an important influence of obesity. Diseases related to poor nutrition – such as diabetes, heart disease, stroke and some cancers – are among the leading causes of disability and death in the United States. Poor diet and lack of exercise come second only to tobacco use in actual causes of preventable death (Ashe et al. 2007). Globally, the proportion of disease burden attributable to higher-than-optimal BMI is 21% for ischemic heard disease, 23% for ischemic stroke, 58% for type two diabetes and 12% for colon cancer (Mhurchu et al. 2005). In one study in the United States, over half (53%) of all deaths in women with a BMI greater than 29kg/m^2 could be directly attributable to their obesity (Manson et al. 1995). As BMI increases, so to does the proportion of people with one or more co-morbid conditions, leading to an average 9 year reduction in life expectancy (Dowler et al. 2007). As a result of overweight conditions and obesity, it is estimated that the loss of healthy life (years of life spent without disability or ill-health) will increase by one

third over the next 20 years (Moon et al. 2007). In New Zealand, it has been estimated that two of every five deaths are attributable to nutrition related factors (MOH 2003b). In fact, one study found that a small reduction in BMI ($0.3kgm^2$) and effective policy changes could prevent approximately 285 deaths each year from 2011, of which approximately two-thirds represent diabetes deaths (Mhurchu et al. 2005).

While there have been a number of interventions designed to address the growing obesity epidemic, both internationally and in New Zealand, there has been overall little success. This is partly due to the fact interventions have focused on individual level risk factors and individual health rather than on environments to which individuals are exposed (Macintyre et al. 2002). This argument can be applied to many lifestyle diseases other than obesity, suggesting a need to focus on the environment in order to understand the role it plays in influencing health.

2.3 The Importance of Place

The understanding that the environment we live in is as important as who we are in affecting individual-level health outcomes is not a new idea. Increasing urbanization in seventeenth century England created special interest in the relationship between the environment and health. Observations were often made that those living in the country versus a city dwelling experienced better health (Macintyre and Ellaway 2003). Despite this, research examining the influence of the environment on health has only gained strength since the early 1990's (Macintyre et al. 2002).

The political climate at the time of research is important in understanding why 'place' research is only a new concept. Since the 1950s, methodological, conceptual and

political individualism was dominant in many industrialized countries. This emerged partly from the 'epidemiological transition,' which emphasized the role that individual lifestyle choices (such as diet and exercise) played in chronic disease (Macintyre et al. 2002). This was further reinforced by the resurgence of neo-liberalism in many of the developed countries. The concept behind neo-liberalism can be summed up by Margaret Thatcher in her remark that 'there is no such thing as society, there are only individuals'. This led to an increased focus on the role of the individual and their impact on human health, rather than the role of the environment (Navarro 1999, Coburn 2000). As well as this, increased emphasis on the role of the market downplayed the role of planning and its importance in modifying the environment.

An over-emphasis on the role of individual health behaviours has tended to ignore the influence of the complex social and physical context in which individual behavioural decisions are made. However, the emergence of the 'new public health' has redirected attention back towards structural and environmental influences of health and health behaviours (Baum 1998). It calls for researchers to look upstream at the causes of poor health and inequalities in health, rather than downstream at their expression in individual behaviours of ill-health (Kreiger 1994). It has been suggested that research focusing on the individual has had limited success in explaining the differences in health outcomes, and that the widespread and increasing prevalence of obesity in particular is inadequately explained by individual level, psychological and social factors (Cummins and Macintyre 2006). The new public health's increased concern for communities and behaviour change has led to a new focus on how the exposure to certain environments encourages obesity.

2.4 Context versus Composition Explanations

In attempting to understand the variation of obesity in an area, questions have been raised regarding whether it is more important to focus on features of the local social and physical environment (Macintyre et al. 1993, Diez-Roux 1998), or if it is more important to focus on people (Slogget and Joshi 1994). This has led to what has been called the 'composition versus context' argument. Compositional explanations suggest that geographical differences in health outcomes are entirely due to the characteristics of individual residents living in those areas (Cummins et al. 2005a). On the other hand, contextual arguments suggest that spatial differences in health are a product of the exposure to features and characteristics of the area in which individuals live. For example, children in deprived areas may not play in the open air because their families do not have gardens or the resources to take them to parks (a compositional resource based explanation), or because few public play parks are provided in their neighbourhood and there are no good public transport links to those that do exist (a contextual resource based explanation).

Traditionally, the contextual and compositional arguments have been seen as mutually exclusive and competing. This has led to investigators aiming to establish whether there is any explanatory role for context after taking composition into account and how much of the observed geographical variation this context might explain (Macintyre et al. 2002). However, the distinction between the two may not be as clear or as useful as it was hoped. Macintyre et al. (2002) suggests that the properties of individuals or households are themselves shaped by the properties of the locality. In other words, both composition and contextual explanations are shaped by one another and are not a fixed category to which explanations for health outcomes can be attributed to one or the other.

Recently, a third argument has been developed to explain variation once composition and contextual influences have been excluded. This is the role of human agency and individual perception. It is known as the social environment collective explanation which draws our attention to socio-cultural and historical features of communities (Macintyre et al. 2002). This explanation requires that we understand the viewpoints of the local community to explain certain health outcomes. To use the previous example of children's use of parks, a collective explanation may explain why parks are not utilized once compositional and contextual explanations are accounted for. For example, within the prevailing local culture, play may not be seen as something that is important to children, or it may not be perceived as desirable or safe for children to play in public places (Macintyre et al. 2002). Understanding the perceptions of the local community is therefore important and can have a significant influence on contextual and compositional explanations.

2.5 Compositional and Contextual Determinants of Obesity

In this section the key compositional and contextual factors that could influence obesity variation are addressed. While this thesis intends to focus on the influence of the built environment on obesity, understanding the role of compositional features such as age, sex and socioeconomic status is also important.

2.5.1 Compositional Influences

There is an extensive body of literature that supports the idea that variation in obesity can be largely explained by compositional influences. The key compositional influences of obesity are outlined in Figure 2.1 and further explanation is provided as to how these explain and influence obesity variation within the population.

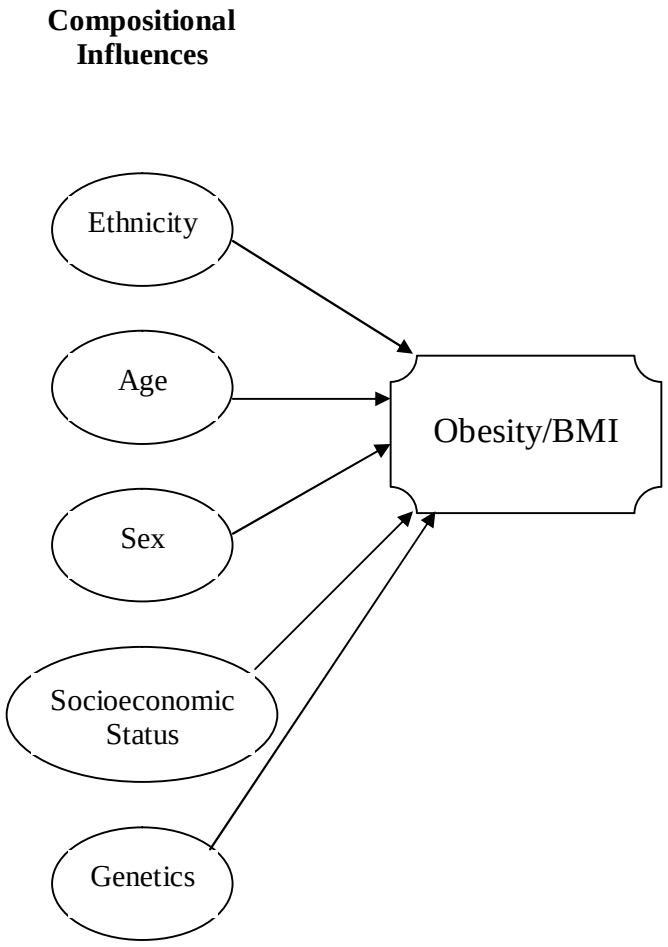

Figure 2.1: Conceptual diagram of the compositional influences of obesity

2.5.1.1 Ethnicity

Research has shown that individuals of certain ethnicity have a greater likelihood of being obese than their European counterparts (Duncan et al. 2004, Phuong Do et al. 2007, Eid et al. 2008, Bodea et al. 2009). As a result, health problems linked to obesity are disproportionately experienced by individuals of certain ethnic groups. In New Zealand, Maori and Pacific Islanders experience higher rates of obesity than New Zealand Europeans. Studies have shown that obesity rates in Maori and Pacific Island populations are 1.9 and 2.5 times higher respectively (MOH 1999). This gap is higher for children with Maori and Pacific Island children being 3 and 5.3 times (respectively)

more likely to be obese than New Zealand European children (MOH 2003c). Differences in the body frame/build of different ethnic groups may explain these patterns. Studies have shown that individuals with low sitting height generally have a lower BMI which can change the percentage of body fat of that individual (Norgan 1994). Also, cultural perception of a healthy body can be an important influence. Several studies have shown that the perception of body size varies with culture and ethnicity and can influence the development of obesity (Sobal and Stunkard 1989, Flynn and Fitzgibbon 1998, Potti et al. 2009). In Western societies, thinness is associated with self-control, elegance, youthfulness and attractiveness, however in some countries, including many Pacific Island nations, obesity is admired and seen as sexually desirable and a symbol of social success, health and wealth (Holdsworth et al 2004, Craig et al. 1996).

2.5.1.2 Age

Changes in adult prevalence of obesity are reflected by an increase in childhood and adolescent weight in both industrialized and developing countries. Studies have shown that the early onset of obesity in children can lead to an increased likelihood of obesity in later life, as well as an increased prevalence of obesity-related disorders (Dietz 1994, Kotani et al. 1997). In both men and women the prevalence of persons who are overweight and obese increases with age until 50 to 60 years and is particularly apparent between the ages of 20 and 40 years (Kopelman 2000). Decreases in muscle mass are suggested as a possible explanation as to why obesity prevalence decreases after age 60 (Gallagher et al. 1996, Zamboni et al. 1997).

2.5.1.3 Sex

A number of studies suggest that gender may influence the prevalence of obesity (Sundquist & Johansson 1998, Winkleby et al. 1999, Shi and Clegg 2009). These studies have shown that, regardless of ethnicity or age, men have a lower percentage of body fat than women (Gallagher et al. 1996). This trend is prevalent when examining obesity in New Zealand as 31.5% of the female population are obese compared to only 23% of the male population. The role of the fashion industry and the media may have an important influence in the perception of women's bodies. Body image literature suggests that the socio-cultural environment may contribute to the development and maintenance of body dissatisfaction by the transmission of norms of thinness through the mass media, specifically advertising by the fashion, beauty and cosmetic industries who stand to gain from women's body dissatisfaction (Thompson et al. 1999). These media emphasize the desirability of thinness, an ideal accepted by most women although impossible for most to achieve (Tiggeman et al. 2005). As a result, there is a tendency for fatness to be despised and for thinness to be venerated (Longhurst 2005).

2.5.1.4 Socioeconomic Status

The relationship between deprived, or low income neighbourhoods, and level of obesity has been studied extensively, with associations being reported in the UK (Ellaway and Macintyre 1996, Ellaway et al 1997), Sweden (Sundquist et al. 1999), Australia (Turrell et al. 2004, Dollman et al. 2005), Canada (Moffat et al. 2005) and Argentina (Aballay et al. 2009). Analysis of the prevalence of obesity by socioeconomic status in England and Wales demonstrates a strong gradient related to social class, especially in women, ranging from 10.7% in social class 1 (low deprivation) to 25% in social class 5 (high deprivation) (Kopelman 2000). As levels of physical activity are an important influence

of obesity, decreased activity displayed by individuals living in highly deprived neighbourhoods puts them at higher risk of developing obesity. New Zealand also demonstrates a similar pattern in non-Maori females, where lower socioeconomic position and higher deprivation is associated with progressively heavier body weight and wider abdominal girth (MOH 2006b).

2.5.1.5 Genetics

The genetics of an individual can play an important role in obesity variation. Twin, adoption, and family studies have now established that an individual's risk of obesity is increased when he or she has relatives who are obese (Meyer and Stunkard 1993, Maes et al. 1997). Other studies have shown consistently that ~40 to 70% of the variation in obesity-related phenotypes such as BMI, sum of skin fold thickness, fat mass, and leptin levels can be inherited from an individual's parents (Comuzzie et al. 1993). Apart from rare obesity associated syndromes, the genetic influence seems to operate through susceptibility genes. While not essential for its expression, or by themselves sufficient to explain obesity, the presence of genes such as this can increase the risk of excess weight (Kopelman 2000). These differences in genetic susceptibility within a population can determine who are most likely to become obese in any given set of environmental circumstances.

These compositional influences of obesity are not discrete variables. Each factor interacts with another resulting in certain individuals being more likely to be obese than others. The influence that these compositional factors have can be further exaggerated by the neighbourhood environment of the individual to the point that the combination of

being individually predisposed to, and living in a neighbourhood which promotes obesity can significantly increase an individual's propensity to be obese.

2.5.2 Contextual Influences

The neighbourhood environment we live in can have important consequences for our health and for the levels of obesity in an area. Before examining how features of the built environment can vary within a neighbourhood, it is important to define what a neighbourhood is.

2.5.2.1 What is a neighbourhood?

In health research, the concept of a neighbourhood has been used loosely to refer to a person's residential environment which is hypothesized to have both material and social characteristics potentially related to health (Diez-Roux 2001). Despite this, there is no absolute definition regarding the size of a neighbourhood. In the early twentieth century, a neighbourhood was a cellular, bounded, inwardly focused and relatively self contained area (Forrest and Kearns 1999, Diez-Roux 2001, Macintyre et al. 2002).

It was originally intended to represent a place that characterized a sense of community and provide opportunities for leisure, recreation and social interaction while being safe, secure and protected. At present, a neighbourhood is usually defined as an arbitrary area based on an area for which data is easily available. Due to this, administratively defined areas such as meshblocks (Pearce et al. 2006, Pearce et al. 2007a), or census boundaries (Morland et al. 2002, Booth et al. 2005, Mujahid et al. 2008) have been used as rough proxies for a neighbourhood area. Alternatively, some studies have defined a neighbourhood using an arbitrary buffered area defined using a Euclidean radius from a

specified point. Studies have suggested using these buffers to define a neighbourhood as they approximate a maximum walking distance and typical short driving distance to resources within a neighbourhood (Donkin et al. 2000, Algert et al. 2006).

Results from reports examining whether different definitions of neighbourhood area has similar implications for health are mixed. Research by Flowerdew et al. (2008) experimented with a number of different neighbourhood boundaries and found that the way neighbourhood boundaries are drawn does have important implications on research results. Alternatively, a study examining neighbourhood variation in childhood accidents using computer generated versus planning designed neighbourhoods found that the different sizes and shapes of a neighbourhood area had very little effect on the variation of accidents (Haynes et al. 2008).

When examining the definition of neighbourhood, it is also important to consider the perceptions of residents in the area when defining their neighbourhood. An individual's subjective definition of their neighbourhood area can differ widely to an academic definition as there is a tendency to define their neighbourhoods in terms of individual use patterns (Hester 1984). An individual's perception of their neighbourhood can vary significantly based on their social class and location. For example, a study examining the perceived extent of gang territory by gang members indicated that there were a wide range of conceptions of the areal extent of the turf, and that this area extended much farther than planners had originally considered (Porteous 1973). Other studies examining the different definitions of a neighbourhood and knowledge of the surrounding area have shown that an upper class individual with access to a wider

variety of resources will have a very different definition of neighbourhood compared to a lower class individual (Orleans 1967, Ladd 1970).

On average, people tend to define their neighbourhood as an area whose size is quite independent from the density of people living in it (Gould and White 1974). In other words, people do not think of their neighbourhoods in terms of the number of people, as planners and academics often do, but only as a comfortable and familiar space around them.

Resources such as parks, land use and the local food environment vary between neighbourhoods and can influence both our physical activity levels and dietary behaviour. Figure 2.2 outlines six of the important features of the built environment used to explain obesity variation between neighbourhoods. These six features were selected for this thesis on the basis that the literature examining environmental influences on obesity defines variation in these features as the most important influences of excess weight.

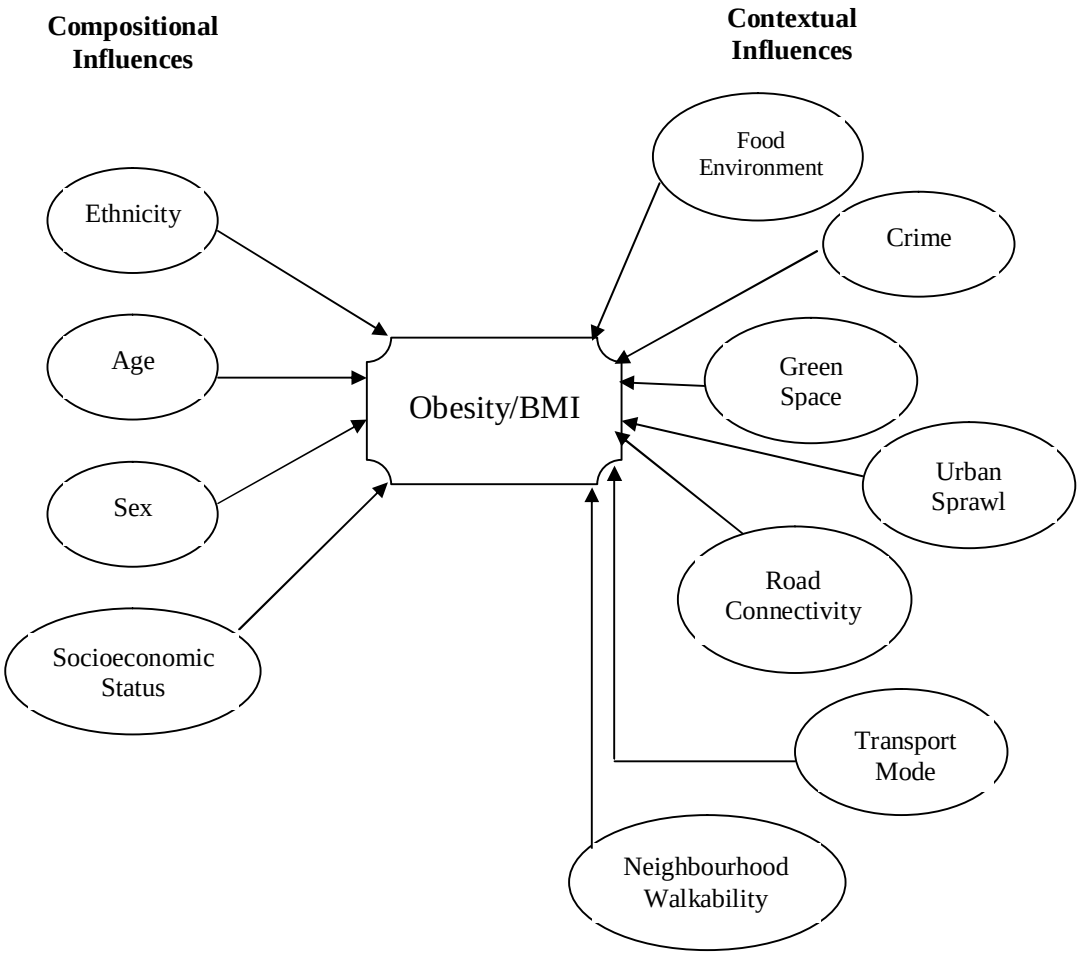

Figure 2.2: Conceptual diagram of the contextual influences of obesity

The role each of these factors has in influencing obesity is briefly outlined in Table 2.1 and is the focus of the next section of this chapter. Understanding how these resources can influence levels of obesity in the population, and how their location and quality varies in diverse neighbourhoods can have important policy implications through influencing the future location and prevalence of resources within a neighbourhood.

Contextual Influence	Influence	Effect
Urban Sprawl	Encourages greater reliance on automobile transport, decreases likelihood of walking as a mode of transport	Discourages Physical Activity
Transport Mode/ Road Connectivity/ Walkability	High connectivity influences the dominant transport mode and how walkable the surrounding environment is	Encourages Physical Activity
Mixed Land use	Increases the connectivity of the area by providing a number of destinations to walk to	Encourages Physical Activity
Food environments	Presence of fast food, takeaways, petrol stations bakeries and dairies Presence of supermarkets, fruiterers, butchers and full-service restaurants/cafes	Discourages healthy dietary behaviour Encourages healthy dietary behaviour
Green Space/ Physical Activity	Increased access to green space and physical activity facilities	Encourages physical activity
Crime and Safety	Evidence of, fear of, and perception of crime	Discourages physical activity

Table 2.1: Brief summary of the influence each of the built environment features has on diet and physical activity behaviour

2.5.2.2 Urban Sprawl

It is important to note that none of the studies reviewed claim that sprawl is one of the main drivers of obesity. Instead, they suggest that differences in the characteristics of the built environment may help explain the large observed spatial differences in the prevalence of obesity, and imply that urban planning can be used at a policy level to reduce the incidence of obesity (Eid et al. 2008). While there is no widely accepted definition of urban sprawl, many associate it with low density, discontinuous and decentralized development (Lopez-Zetina et al. 2006). Research has shown the development densities are slowly decreasing, that is, the number of people per development is dropping. This decline partly reflects the continued growth of suburban

areas and the rise of car ownership which made locations that were previously inaccessible by other means of transport readily available. This led to development away from the compact, dense neighbourhood with a grid network of streets (small blocks with streets at right angles to each other), towards a spacious neighbourhood abundant with cul-de-sacs, and single roads connecting large areas of development (Figure 2.3).

Figure 2.3: Example of road networks with differing degrees of connectivity. The example on the left is a traditional grid network of streets. The example on the right shows a typical sprawling neighbourhood with a number of cul-de-sacs. (Frank et al. 2003:119)

Urban sprawl has been connected to obesity through its influence on physical activity (Kelly-Schwartz et al. 2004, Ewing et al. 2006). It is said to encourage a greater reliance on automobiles for transport and discourage walking and physical activity (Kelly-Schwartz et al. 2004). Research from the United States suggests that adults living in more sprawling counties have a higher BMI and are more likely to be obese (Joshu et al. 2009, Garden and Jalaludin 2009). In fact, the odds of being overweight or at risk of overweight in a more sprawling county can be up to 1.16 times higher than the odds of being overweight or at risk in a more compact county (Ewing et al. 2006). Research has shown that this can be directly related to the road network, where

residents in metropolitan areas of highly accessible, gridded street networks and low levels of urban sprawl have higher health ratings and lower levels of BMI (Kelly-Schwartz et al. 2004).

Consensus regarding whether urban sprawl is a determinant of obesity is mixed. Other studies have reported that decreased density does not always cause obesity (Oakes et al. 2008, Ewing et al. 2003). These studies suggest that greater urban sprawl can increase residents' physical activity, a result that is opposite to most findings of urban sprawl and obesity (Oakes et al. 2008, Schoenborn et al. 2002). Ewing et al. (2003) suggests that the common relationship between obesity and urban sprawl may arise as a result of self-selection, that is, an individual's propensity to choose a more sprawling neighbourhood. For example, an individual who does not like to walk or do any physical activity is more likely to be obese, and as a result, may choose an area to live in where they can easily travel by car.

2.5.2.3 Transport Mode/Connectivity/Walkability

The prevalent transport mode, connectivity of the surrounding road system and ease of walkability of a neighbourhood can be an important determinant of obesity. These features can be influenced by the extent of urban sprawl of a neighbourhood. A neighbourhood with increased reliance on automobiles, decreased connectivity of the road network and decreased levels of walking, both as a mode of transport and as a leisure activity, is more likely to promote obesity. Of these, connectivity of a neighbourhood is the most important influence. Connectivity refers to the number and directness of transportation linkages between destinations (Frank and Engelke 2005). A

neighbourhood with high connectivity provides many linkages between destinations and can influence the dominant mode of transport and walkability of a neighbourhood.

The dominant mode of transport in a neighbourhood is an important influence on obesity as neighbourhoods encouraging increased automobile transport are associated with a higher risk of being obese (Frank et al. 2004, Wen et al. 2006, Frank et al. 2007, Samimi et al. 2009). For example, an additional 60 minutes per day in the car can lead to a 6% increased odds of being obese (Frank et al. 2004). This was compared to walking as a mode of transport which found that the odds of being obese decreased by 4.8% for every kilometre walked. In fact, in a study looking at automobile use, among individuals driving more than ten times a week 47% were overweight or obese, compared with 41% of those driving between six to ten times, and 30% among those driving less than six times a week (Wen et al. 2006). This suggests that the increasing reliance on the car as the dominant mode of transport is a possible area for planning policy to investigate in order to reduce the obesity epidemic.

Neighbourhood walkability is also an important influence of levels of physical activity, however, there is debate about the extent to which it influences obesity (Saelens et al. 2003, Ewing et al. 2003, Berke et al. 2007, Frank et al. 2007, Scott et al. 2009, Sallis et al. 2009, Sallis and Glanz 2009). For example, studies have shown that residents in high walkability neighbourhooods engaged in approximately 70 more minutes of moderate physical activity per week than residents in a low walkability neighbourhood (Saelens et al. 2003, Inoue et al. 2009). This directly influenced their obesity levels as 60% of the low walkability residents were overweight compared to only 35% of the residents in the high walkability neighbourhood (Saelens et al. 2003). As a result,

residents of high walkability neighbourhoods displayed decreases of up to 1.2kg in weight and a 1.57 centimetre loss of waist circumference (Li et al. 2009a). Alternatively, studies by Berke et al. (2007) and Scott et al. (2009) found that while a more walkable neighbourhood has a denser street network and better connectivity, there was no significant association between higher neighbourhood walkability and the proportion of residents in the overweight or obese range.

2.5.2.4 Mixed Land use

The concentration of different kinds of land use in an area can have an important effect on levels of obesity in a neighbourhood. The phrase "mixture of uses" refers to the spatial placement of different types of uses. There are five different kinds of land use: residential (housing), commercial (shopping facilities), industrial (factories), recreational (parks and beaches) and institutional (schools, churches and libraries). When uses are mixed, there is a greater range, if not number, of destinations that are close to a person's house or office (Frank and Engelke 2005). Historically, cities have been designed with a strong downtown commercial district surrounded by dense residential areas and industrial areas also close to worker housing (Lopez and Hynes 2006). Decades of suburbanization have resulted in large tracts of residential housing located away from the inner city and job market. This has ultimately resulted in fewer individuals being able to walk or take local public transport to work, longer commutes to work, and an increase of reliance on automobiles.

Studies investigating the effects of mixed land use on obesity have found that greater levels of mixed land use decreases the obesity of residents in a neighbourhood (Frank et al. 2004, Li et al. 2004, Mobley et al. 2006). These studies have shown that the

proportion of obese individuals declined from 20.2% in the lowest land use mix quartile to 15.5% in the highest land use mix quartile (Frank et al. 2004). Increased land use mix has also been associated with significantly higher levels of walking activity as a result of having a greater number of destinations to walk to (Li et al. 2004). Due to the increased level of walking and physical activity, residents living in high land use mix neighbourhoods had a BMI 2.6kg/m^2 lower than those living in a single use environment (Mobley et al. 2006, Rundle et al. 2007).

2.5.2.5 Food environments – supermarkets, fast food and restaurants

The variety of food environments available in a neighbourhood can have important implications for obesity levels. Literature examining the relationship between food environments and obesity can be divided into two sections; those studies which examine the health effects of food resources; and research which examines how the food environment varies by deprivation. Fast food restaurants provide high fat content, low nutrient meals and have been linked to increased BMI and weight gain (Jeffery and French 1998, French et al. 2000, Frank et al. 2009, Li et al. 2009b). Alternatively, the location of a supermarket in a neighbourhood can have a positive effect. Studies predominantly in the United States have shown that the presence of supermarkets is associated with a lower prevalence of overweight and obesity (Morland and Evenson 2009). For example, Morland et al. (2006) found that compared to people who lived in neighbourhoods without a supermarket, a 9% lower prevalence of overweight, 24% lower prevalence of obesity and 12% lower prevalence of hypertension was observed in areas with at least one supermarket. How these resources vary by neighbourhood is therefore important in understanding obesity variation.

Generally, research has shown that access to food required in maintaining a 'healthy' weight is worse in neighbourhoods of greater deprivation, with more affluent neighbourhoods having better access to supermarkets and specialty stores (Chang 2006, Morland et al. 2006, Cummins and Macintyre 2006, Seliske et al. 2009, Ball et al. 2009). Neighbourhoods which have inadequate access to food provision have been described as 'food deserts' (Clarke et al. 2002). Food deserts are most commonly areas of inner cities where cheap, nutritious food is virtually unobtainable. As a result, car-less residents unable to reach supermarkets, depend on the local dairy or convenience store where prices are high, products are processed, and fresh fruit and vegetables are poor or non-existent (Cummins and Macintyre 2002).

Reports from the United Kingdom, United States and Australia have displayed relationships advocating food deserts in neighbourhoods of high deprivation and certain ethnicity (Morland et al. 2002, Reidpath et al. 2002, Cummins et al. 2005b, Morland et al. 2006, MacDonald et al. 2007, Galvez et al. 2009, Bovell-Benjamin et al. 2009). These studies claim that the greater the level of deprivation in a neighbourhood, the more likely that a neighbourhood will be exposed to global fast food companies (Cummins et al. 2005b, MacDonald et al. 2007). In fact, a review in Australia has shown that in neighbourhoods of low socioeconomic status, fast food restaurants are 2.5 times more prevalent than affluent neighbourhoods (Reidpath et al. 2002). The presence of a greater amount of fast food restaurants in one neighbourhood increases the potential for residents to be obese through its limitation of healthy food provision.

Research investigating the location of supermarkets in neighbourhoods has provided further support for the presence of food deserts (Zenk et al. 2005, Chang 2006, Morland

et al. 2006). Neighbourhoods with a higher population of African American residents have been found to have considerably lower access to supermarkets and healthy food (Chang 2006) as these supermarkets are located significantly further away from African American neighbourhoods relative to white neighbourhoods (Zenk et al. 2005). In certain areas in the United States, higher deprivation neighbourhoods have as many as three times fewer supermarkets than the low deprivation neighbourhoods (Morland et al. 2006). These neighbourhoods rely on small independent grocery stores, where the cost of grocery items are higher due to a decreased bulk buying power of these facilities compared to supermarkets (Cummins and Macintyre 2006, Wang et al. 2007, Powell et al. 2007).

Not all research has been able to prove the presence of food deserts. While literature from the United States and some areas of the United Kingdom have generally proven a relationship between the level of deprivation and prevalence of fast food restaurants and supermarkets in a neighbourhood, international research has found that not all high deprivation neighbourhoods are food deserts (Graddy 1997, Whelan et al. 2002, Simmons et al. 2005, Macintyre et al. 2005, Macintyre et al. 2008). For example, in Victoria, Australia, a paper investigating the relationship between fast food availability and obesity found that while non-fast food consumers had a lower BMI than fast-food consumers, the difference between the two BMI's was insignificant (Simmons et al. 2005). Similarly, research has found that the price for certain food items in more deprived neighbourhoods was lower than less deprived neighbourhoods (Mooney 1990, Cummins and Macintyre 2002), with one study finding that fast food restaurants in New Jersey and Pennsylvania charged more for fast food in high deprivation African American neighbourhoods (Graddy 1997). Combined with this, research by Crawford

et al. (2009) suggests that the BMI of girls aged 13-15 and their fathers increased as the distance to at least one fast food outlet increased. This suggests that the relationship between fast food consumption and obesity may not be as straightforward as previously implied.

2.5.2.6 Physical activity/Green space

The link between physical activity and obesity is well known, with recommended amounts of physical activity in combination with a well-balanced diet being an important determinant of health and body weight (Berke et al. 1999). The access that an individual has to green space areas promoting physical activity is important. Research in the United States and United Kingdom has found that areas of higher deprivation have less access and lower quality green space than the more affluent areas (Macintyre et al. 1993, Coen and Ross 2006).

Studies have shown that, regardless of the socioeconomic status of an area, increased access to green space has a positive influence on levels of physical activity (Giles-Corti et al. 2003, Ellaway et al. 2005, Kegler et al. 2009). For example, individuals with poor access to recreational facilities have a 68% greater chance of being obese (Giles-Corti et al. 2003), while individuals who have greater access to areas of physical activity are 50% more likely to achieve high levels of walking (Giles-Corti et al. 2005). This is largely connected to the aesthetics of the area. A high amount of greenery and lack of incivilities such as litter and graffiti can encourage individuals to participate in physical activity. Studies show that for individuals living in areas containing a high level of greenery, the likelihood of being more physically active is more than three times as high, and the likelihood of being overweight and obese is approximately 40% less

(Ellaway et al. 2005). Access to a sports field or additional fitness facility per 1000 residents has been associated with a BMI between 0.23kg/m^2 to 1.39 kg/m^2 lower than neighbourhoods without access (Mobley et al. 2006, Stafford et al. 2007). These studies suggest that a relationship between physical activity and BMI is evident, and that the level of access an individual has to an area of green space can significantly influence the likelihood of engaging in adequate levels of physical activity and reducing obesity.

Levels of deprivation and ethnicity of an area also have an important influence on access to green space with access decreasing as deprivation increases. As deprivation increases, the quality of resources and access to green space decreases (Kennedy et al. 1998, Gordon-Larsen et al. 2006, Blakely et al. 2007). For example, in the United States, for every 100% increase in the proportion of individuals that have tertiary education or higher, a greater than twofold increase in facility access occurs (Gordon-Larsen et al. 2006). Alternatively, high-minority, low-educated neighbourhoods are half as likely to have at least one physical activity facility. This is important as having just one physical activity facility can decrease the relative odds of being overweight by 5% compared to a block with no physical activity facilities.

As well as a less access to facilities, the quality of facilities can be poorer in high deprivation neighbourhoods (Lee et al. 2005, Coen and Ross 2006). Highly disadvantaged areas often have higher levels of graffiti, litter, unsafe play structures and less access to appealing areas to engage in physical activity than neighbourhoods of good health and low disadvantage (Lee et al. 2005). However, this finding largely depends on the wider area as Ellaway et al. (2007) found that more play areas were

observed in areas of higher deprivation, a contrast to the findings of many of the studies in other countries.

2.5.2.7 Crime and safety

Neighbourhood crime and safety can have an important influence on the prevalence of obesity. High levels of crime in a neighbourhood may cause individuals to feel unsafe and provide a barrier to engaging in the recommended amounts of physical activity. As with other influences of an obesogenic environment, the level of deprivation of a neighbourhood can have an important effect on the relationship between crime and obesity.

The presence of crime in a neighbourhood erodes community trust, marginalizes residents, creates individual stress and affects the social environment. Fear of crime is likely to keep individuals indoors, particularly the old and the young, and to discourage physical activity (Lopez and Hynes 2006). A higher crime rate can also be associated with higher levels of incivilities such as litter and graffiti. The presence of this all contributes to an increased feeling of being unsafe in one's own neighbourhood. Individuals from low socioeconomic neighbourhoods are less likely to agree that the neighbourhood is safe for walking, and are less likely to have positive perceptions of their environment in general (Kavanagh et al. 2007). Findings also suggest that there is a relationship between the ethnicity of a neighbourhood and safety. Studies in the United States have shown that as the proportion of African American residents increase, neighbourhood playground safety decreases by 0.12% (Cradock et al. 2005).

Little research has been conducted on the influence of crime on obesity and, as a result, the relationship is debated. High crime levels in a neighbourhood can be associated with a decrease in the likelihood of falling in the highest category of moderate to vigorous physical activity (Gordon-Larsen et al. 2000). In neighbourhoods containing high levels of incivilities, the likelihood of being physically active is approximately 50% less, and the likelihood of being overweight or obese is approximately 50% higher (Ellaway et al. 2005). However, a paper by Burdette et al. (2004) investigating the link between the proximity of children's residences to playgrounds and the safety of these neighbourhoods found that there was no clear trend suggesting that lower levels of neighbourhood safety influences the prevalence of excess weight.

Many of these studies have not accounted for the influence of individual perception on the relationship between crime and obesity. Regardless of whether a neighbourhood is actually a high crime area or not, the perception of the individuals living in that neighbourhood will have an influence on whether that environment is deemed safe for physical activity. If it is deemed unsafe, the chances of it being used for this purpose decrease. This is especially apparent in regards to children's freedom to move around their neighbourhood. Parents' fears about their children being victims of crime may result in increased supervision (De Vaus and Wise 1996). This influences mode of travel to school, creates restrictions on where children can go and increases monitoring of children at all times (Tranter and Malone 2003, Ridgewell et al. 2009). The perception of an environment by an individual is therefore an important influence on obesity. Encouraging an environment which is perceived as safe may be one way of combating the rising obesity levels.

2.6 The New Zealand Literature

In respect to the New Zealand literature, many areas are identified that warrant further investigation. Many of the relationships established in the above section are a product of international research. At present there has been little research conducted in New Zealand investigating the influence of built environment features on obesity. The small amount available has focused largely on the food environment and green space arena. From this research, the relationship New Zealand has between community resources, food environments and deprivation differs from the common relationships in international literature.

In a study examining community resources between Waitakere City and North Shore City in Auckland it was found that while cities with a higher level of personal wealth and lower deprivation have higher levels of community resource access between the two cities, within cities, neighbourhoods of higher deprivation generally had higher community resource access (Field et al. 2004). As expected, a higher level of resource accessibility is available in urban areas rather than rural neighbourhoods (Pearce et al. 2008a); however, as with the study above, within urban areas, access to all types of community resources is better in more deprived neighbourhoods (Pearce et al. 2008a). Studies calculating travel distances to the closest fast food outlet have found that, like the international literature suggests, travel distance is shorter in the most deprived neighbourhoods, however, access to supermarkets and other shops selling healthy food is also greater than more affluent neighbourhoods (Pearce et al. 2007a, Pearce et al. 2007b). In fact, neighbourhoods with greater access to fast food restaurants were less overweight and had a 17% higher odds of eating the recommended vegetable intake (Pearce et al. 2009) suggesting that consumption of the recommended fruit and

vegetable intake is not associated with neighbourhood access to supermarkets or convenience stores (Pearce et al. 2008b).

Results of research conducted in New Zealand regarding access to green spaces and physical activity is mixed. While some research has shown that access to parks and recreational centres improves as area level deprivation increases (Pearce et al. 2008a), others suggest that sedentary behaviour is less, and physical activity higher, in neighbourhoods with worse access to recreational amenities (Witten et al. 2008). These studies suggest that further research is needed in order to understand the influence that deprivation has on features of the built environment, and in turn how these features affect obesity levels.

2.7 Reasons for Obesity Variation in Neighbourhoods

The location and quality of resources promoting an obesogenic environment varies greatly between neighbourhoods. This can lead to one neighbourhood being a more obesogenic than an adjacent neighbourhood. Throughout all of the studies outlined above, the degree of deprivation of a neighbourhood has had some influence on the location and quality of these resources. The effect of community empowerment, the local planning structure, the 'Not in my backyard' (NIMBY) phenomenon, and individual perceptions of the neighbourhood all help to explain the variation seen in the distribution of these resources.

2.7.1 Planning

Local planning policies can have an important influence and can be viewed as either a hindrance or help to a neighbourhood. Poor planning measures can lead to

environments which encourage obesity and unhealthy behaviours. In order to understand why neighbourhoods may vary in the type and quantity of resources it is important to understand the planning measures that made them what they are.

Land use planning and zoning originally developed in response to public health needs (Ashe et al. 2003). One of the most obvious planning strategies was the move to decentralise the crowded, unsanitary living conditions of nineteenth century England (Frank et al. 2003). Zoning legislation passed in the 1920s laid the foundations on which today's cities are built, and provide a legal tool both governments and planners can use to control development (Frank et al. 2003). Most recently, zoning and planning rules have been used to control the proliferation of establishments promoting poor nutrition and lifestyle behaviours. These rules offer creative opportunities for communities to exert control over public health, safety and welfare if utilised correctly. For example, the 'New Urbanism' movement which emerged in the late 1980s encourages pedestrian centred neighbourhoods where economic and social activities are within a five minute walk, mixed land use and community orientation around public transport (Duhl and Sanchez 1999, Lake and Townshend 2006).

The distribution of resources in a community is largely dependent on the popular planning methods at the time. In post-war New Zealand, many peri-urban or rural areas were transformed into large scale suburban developments resulting in the rapid outward movement of people from city centres, and reliance on the automobile (Field et al. 2004). These planning approaches changed patterns of community resource access from clusters of mixed-use centres to separation of community, business, social and recreational activities (Saville-Smith 1999). These low-density suburban developments

on city fringes are likely to have lower levels of community resource access than older centres developed under mixed-use planning models (Field et al. 2004).

With a change in the dominant planning measures, often previous successful planning initiatives are discarded. Recently urban planning has undergone an analogous shift in its orientation toward environmental health by adopting an environmental impact assessment process for analysing the ecological and human health effects of plans, projects, programs, and policies (Corburn 2004). The New Zealand Resource Management Act (RMA) (1991) is an example of this which requires an assessment of environmental effects that accounts for all adverse effects before a new development is granted consent. The purpose of the RMA (1991) is to promote sustainable development of both natural and physical resources.

There are however, a number of criticisms of the RMA (1991) and its position on health. While it states that the act will provide for individual health and safety, its greater focus is upon adverse effects to the natural biophysical environment. In fact, one of its distinguishing features is the very limited focus on urban and social planning (Perkins and Thorns 2001). This can effectively allow the development of features of the built environment potentially seen as obesogenic so long as any there are no adverse effects on the environment. An example of this can be seen in Motueka, in the Tasman region of New Zealand. McDonalds gained resource consent to build a new restaurant in Motueka with development to be completed in late May 2008 (McDonalds Official Website 2007). This consent was granted without consultation with the local community, many of whom are opposed to the development for a number of reasons including the health effects it can have on the small town. So while the RMA (1991) has

been a fairly successful attempt at ensuring resources are sustainable and available for future generations, its effect on limiting resources thought to be disadvantageous to health is minimal. This is in part a result of the willingness of neighbourhood communities to work together to influence potentially unwanted resources within their neighbourhood.

2.7.2 Community Empowerment and the NIMBY Phenomenon

Community empowerment is defined as the process of gaining influence over conditions that matter to people who share neighbourhoods, workplaces, experiences or concerns (Fawcett et al. 1995). It aims to reduce the number of people who are helpless by encouraging individuals to work together to meet their respective needs (Baum 2002). This is most commonly associated with political or decision-making power (Fetterman and Wandersman 2005). High levels of community empowerment can result in residents banding together to ensure that their opinions and desires are heard and can ultimately change the environment these individuals live in to their benefit (Kwate 2008). The ability of a community to influence locally valued changes is therefore important when examining obesogenic environments.

A successful result of community empowerment is material change within neighbourhoods including increased access to resources and greater quality of life. This may result in these neighbourhoods having increased access to 'healthy' food options, and resources that encourage physical activity. Alternatively, community empowerment can also result in an increase of what is thought to be an 'unhealthy' food environment. Fast food restaurants are a common way to increase community development and economic growth, especially among minorities. Until the 1960s,

African American restaurant franchisees were extremely rare. When people began to gain access to store ownership, the location of fast food restaurants in a neighbourhood was seen to be a neighbourhood revitaliser in its ability to provide African American youth with their first work experience (Love 1995). As a result, certain communities may welcome the entry of fast food into their neighbourhood, creating an uneasy tension between economic and health needs (Kwate 2008).

The level of community empowerment in a neighbourhood is also linked to feelings of NIMBY, where those communities who are more empowered and able to enforce change in their neighbourhoods may be more likely to object to unwanted land uses in their area. NIMBY (Not In My Back Yard!) refers to the protectionist attitudes of, and oppositional tactics adopted by community groups facing an unwelcome development in their neighbourhood (Dear 1992). While it often is used in regards to the location of many human service facilities such as landfill sites and hazardous waste facilities, it can also be applied to other developments such as the placement of fast food restaurants in a neighbourhood. The term NIMBY comes from the understanding that many of these unwanted facilities are necessary, but not near the residents' homes. This phenomenon has been around for more than 30 years, and occurs as the result of three specific concerns; the perceived threat to property values, personal security and neighbourhood amenities (Piat 2000).

The success of NIMBY opposition is in part determined by the cohesiveness of the neighbourhood and ability for these neighbourhood residents to work together for a common goal. As a result, areas with wealth, property, political power and connections are often able to enact desirable changes and prevent undesirable ones (Shultz et al.

2002). Residents with less political influence often end up on the losing end of the equation (Maantay 2001). This may in part explain why some of the more deprived neighbourhoods have a higher quantity of fast food restaurants. Political influence is likely lower in these areas and NIMBY opposition to a proposed development may fall on deaf ears. Combined with this, lower income neighbourhoods may find themselves facing a difficult dilemma. The potential employment from a new fast food restaurant and the economic benefits that come with the facility being located in their neighbourhood may counter their reluctance to have another fast food restaurant nearby. The Motueka McDonalds mentioned above is an example of NIMBY. Opposition was so strong to the development that a petition was created in an attempt to stop the fast food giant developing in their town ('People of Motueka try to stop McDonalds 2007). Unfortunately, the creation of this petition by residents to stop development was unsuccessful and McDonalds is now fully operational in Motueka.

The strength of NIMBY feelings and community empowerment is an important influence on the variation of resources seen in neighbourhoods by deprivation. The possible helplessness experienced by residents in a higher deprivation neighbourhood and the inability to stop development can result in higher levels of obesity promoting resources locating in a specific area. Further understanding is needed regarding the effects on NIMBY in New Zealand and how this has affected development of unwanted land uses.

2.7.3 Perceptions of the Environment

Finally, individual perception has an important impact on utilisation of obesity influencing resources. The perceived safety of a neighbourhood through which people

pass to reach a service or an amenity, particularly if they are walking, may impact on its use (Pearce et al. 2007a). Perception studies have examined the perception of crime and the aesthetics of the surrounding environment on physical activity (Sooman and Macintyre 1995, Giles-Corti and Donovan 2002, Santos et al. 2009), parental perception of the environment and how it affects their children's physical activity (Timperio et al. 2005, Hume et al. 2009), and perception of an individual's own health (Kennedy et al. 1998). The majority of these studies have looked at the changing perceptions of a resident defined by level of deprivation of a neighbourhood.

Neighbourhood deprivation is an important influence on resident perception. Individuals living in low socioeconomic areas are less likely to perceive that their neighbourhood is attractive, safe, and interesting for walking and that there is social support for walking locally (Sooman and Macintyre 1995, Ellaway et al. 2001, Giles-Corti and Donovan 2002). This can result in individuals in these neighbourhoods being less likely to report excellent health compared to other neighbourhoods, and may directly affect their physical activity levels. In one study, residents who perceived there was no support for walking in the form of green space were 21% less likely to walk for recreation (Giles-Corti and Donovan 2002). Studies have shown that individuals who perceive convenient access to areas of green space and physical activity are up to 5% less likely to be obese (Nelson and Woods 2009).

The perception of crime and physical incivilities in a neighbourhood can also have an important influence on resource use. Physical incivilities such as litter and graffiti have been shown to be positively correlated with residential mobility, fear of retaliation, and perceived physical and social disorder. They are also negatively correlated with

willingness to intervene in acts of delinquency and/or misbehaviour, or provide aid to children in need, and with overall neighbourhood quality (Caughy et al. 2001). This can be described as the 'Broken Windows' theory, which suggests that the appearance of the physical environment provides direct messages that regulate individual behaviour. A disordered physical environment is not only a consequence of neglect, but also a signal to others that behaviours that are usually prohibited are tolerated (Cohen et al. 2000). This can translate into an unwillingness to use the resources available in an environment as their quality is perceived to be inadequate or reduced, or due to a fear of being harmed while using these resources (Gomez et al. 2004)

Parental perception of crime and safety has an important influence on childhood and adolescent physical activity through reducing the likelihood that parents will allow children to utilise areas of green space for physical activity. Perceptions of traffic and the safety of access routes to green space areas can also have an important influence (Hume et al. 2009). For example, children whose parents believed that there was heavy traffic in their local streets were 40% more likely to be overweight or obese than other children, and children whose parents were concerned about road safety were almost four times as likely as other children to be obese (Timperio et al. 2005).

To date, there is no evidence in New Zealand that the perception of the environment can influence physical activity. Despite this, consensus shows that neighbourhoods conducive to promoting low levels of obesity are perceived to have low levels of crime (Timperio et al. 2005), are aesthetically pleasing (Ball et al. 2001), high road connectivity (Berke et al. 2007), proximity to commercial destinations (Frank et al. 2007), and a higher residential density (Saelens et al. 2003). Neighbourhoods that don't

display these characteristics, or have lower quality resources are more likely to be conducive to an obesogenic environment.

2.8 Conclusion

This chapter has outlined the relationship between the built environment and obesity. It has provided an overview of obesity, physical activity and nutrition and explained and examined the importance of place and the role it plays in obesity.

Sections 2.4 and 2.5 introduced the debate between compositional and contextual arguments and their influence on obesity with a specific focus on the relationships between the built environment and obesity. Key features were identified that are important in promoting an obesogenic environment. These were: urban sprawl, transport mode/road connectivity/walkability, land use mix, food environments, green space and physical activity, and crime. Significant relationships between the key features of the built environment and obesity are outlined below:

- Urban Sprawl: Encourages a greater reliance on automobile transport, discourages walking and physical activity, creates decreased connectivity between commercial and residential land use

- Transport Mode/Road Connectivity/Walkability: Road connectivity influences the dominant transport mode and how walkable the environment is. Increases the likelihood that individuals will walk more for both leisure and transport.

- Mixed Land use: Increases the connectivity of the area providing a number of destinations in one neighbourhood. Increases the likelihood that individuals will be able to walk to these destinations, decreasing automobile reliance as a result.

- Food environments: Fast food can contribute to obesity. Supermarkets and full-service restaurants encourage healthier eating. Findings as to whether access to healthy food is influenced by level of deprivation of a neighbourhood are mixed. Results from New Zealand has suggested that access to food resources increase in the more deprived areas

- Green Space and Physical Activity: Access to green space has a positive influence on physical activity levels. Level of deprivation may reduce the quality of green space resources in a neighbourhood, however findings regarding access to green space by deprivation are mixed.

- Crime: Evidence of, and fear of crime, reduce the level of physical activity in a neighbourhood. Perception of crime in a neighbourhood can have just as much influence in decreasing physical activity levels as actual crime.

The final section focused on some of the reasons for variation of resources and their utilisation between neighbourhoods. It investigated the effects of local planning acts, including that of the RMA (1991), the impact of community empowerment and NIMBY opposition, and the influence that perceptions of the environment have in creating obesity variation between neighbourhoods.

The research in this thesis intends to extend understandings of the built environment and its effect on obesity. The limited number of studies reviewed, especially that of the New Zealand context, indicates that considerably more research needs to be conducted in this area to understand how where we live influences obesity. The following chapter introduces the methodology for the examination of the influence of the built environment quality, and the role that individual perception of the environment has on obesity.

Chapter Three
Data and Methods

3.1 Introduction

This chapter will describe the methodology used to achieve the two research objectives outlined in Chapter One, whether the quality of available resources varies within neighbourhoods that differ in terms of social deprivation, and how the perception of these environments among local residents can influence utilisation of these resources. Both qualitative and quantitative methods of analysis were used in this research. A mixed method approach such as this enables a more comprehensive analysis of the data as it examines both objective and subjective influences on obesity within a neighbourhood. Section One outlines the data sources and the procedure of obtaining the data used to examine the first research objective. Section Two details the methods and analytical techniques employed and include the method used to select the neighbourhoods, the development of the site survey tool, and the objective measures used to test the validity of the latter. It also includes the method used to examine residents' perceptions of their neighbourhoods.

3.2 Data Sources

As the primary aim of this thesis is to examine how features of the built environment and their quality varies between neighbourhoods of differing social deprivation, understanding what local resources are available to the neighbourhood and where they are located is important. Chapter Two identified six contextual factors of the built environment that influence obesity however, not all of these can be measured or

displayed using GIS software. For this reason, only a selection of the contextual factors are examined using GIS. Mixed land use, urban sprawl and crime and safety are investigated using the site survey tool mentioned later in this section. The other factors considered, namely the location of food resources, green space and physical activity resources, can be mapped using GIS. These were obtained from a number of different sources (Table 3.1).

Data	Obtained From	Information Contained within dataset
Christchurch Food Premise Locations	Christchurch City Council Health Licensing Office	870 licensed Christchurch Food Premises containing the name of the premises and a physical address
Christchurch Parks/Green Space	Land Information New Zealand, Department of Conservation, Water Safety New Zealand	Parks, playgrounds, waterway reserves and sports grounds within the Christchurch area
Christchurch Sports Facilities and Clubs	Christchurch Yellow Pages Phonebook and online directory	Name of the sports facility and a physical address
Christchurch Bus Shelters, Bus Stops and Bus Routes	Centre for Social and Health Outcomes Research and Evaluation (SHORE)	GIS shape file of all bus shelters, bus stops and bus routes within Christchurch area
Christchurch Walking network	Abley Transport Engineers	Citywide walking network

Table 3.1: Sources of data and their characteristics used in GIS analysis

The Christchurch food premises data were stratified into eight different food categories (supermarkets, petrol stations, takeaways, restaurants/cafes, convenience stores/dairies, bakeries, butchers and fruiterers) for further analysis. The data were stratified so that each food category could be assigned a different symbol to distinguish between different types of food resources. Most of the data were not available in a GIS format and therefore had to be geocoded using geocoding software in ArcGIS to assign map co-ordinates to amenity addresses.

To ensure that as many food and physical activity resources were accounted for as possible in the neighbourhoods, the resources were spot checked. This involved searching through the Yellow Pages online directory (www.yellowpages.co.nz) and other search engines for all relevant businesses within the selected neighbourhood suburb and the surrounding suburbs. As the Yellow Pages rely on the use of specific keywords, a number of variations were used to ensure the maximum number of results. For example, to find all of the local dairies within a neighbourhood, the keywords dairy, dairies, dairy products, grocery stores and convenience store were used in the neighbourhood and its surrounding suburbs. Each food outlet was checked against the database provided by the Christchurch City Council to ensure that they had been accounted for. With more than 95% of the food premises and sports facilities included in the original data sets matching those found in the spot check, the data was deemed to be near complete and suitable for use in this project.

3.3 Methods and Analytical Techniques

The first aim of this thesis is to investigate whether resource quality varies in neighbourhoods that differ in terms of social deprivation. Resource quality variation is examined using a coded systematic site assessment tool and analysed through the ranking and weighting of the built environment features influencing obesity. The second aim, to understand how local residents' perceptions of their environment can influence utilisation of resources, is examined using a questionnaire. The results of these findings can be compared to examine how residents' perceptions of their surrounding neighbourhood compares to the quality and availability of resources located within them.

3.3.1 Selection of the Neighbourhoods

A number of studies have highlighted the importance of neighbourhood effects in explaining geographical and social variations in health (for example Diez-Roux et al. 1997, Diez-Roux 2004). How the quality features of the built environment vary by neighbourhood and how, in turn, these neighbourhoods may promote an obesogenic environment is important in explaining variations in obesity. The following section outlines how the neighbourhoods were selected for this study.

The complexity of defining what a neighbourhood is has been discussed in the previous chapter, however, for the purpose of this thesis, a basic neighbourhood is defined as an area included within an 800 metre buffer of a chosen point. This buffer of 800 metres was chosen as previous health research has indicated that this is approximates a maximum walking distance and typical short driving distance to neighbourhood stores (Donkin et al. 2000, Algert et al. 2006, Pearce et al. 2008b).

When examining the difference between actual resources located in a neighbourhood area versus the perception of the resources in the area, it is understood that the definition of a neighbourhood often changes and can be largely subjective. Perceived neighbourhood areas often vary quite significantly compared to academically defined neighbourhoods as they are often defined according to individual uses rather than the academic use of administratively defined areas such as meshblocks or census areas (Stutz 1974, Hester 1984, Booth et al. 2005, Pearce et al. 2006). To acknowledge that subjective definitions of a neighbourhood often vary from academic definitions, two extra buffered areas were added (1 kilometre and 1.2 kilometres) to test the sensitivity of the neighbourhood area. This can be done by examining an individual's perception

of the extent of their neighbourhood and the resources contained within it and comparing it to the resources contained within each of the three buffered areas to determine which buffer is the best indicator of neighbourhood size. For example, the perception that all the resources an individual needs can be found within two streets of their home can use a neighbourhood area defined as an 800 metre area. This is compared to individuals who believe their neighbourhood encompasses a wider area where a 1 kilometre or 1.2 kilometre buffer as a definition of a neighbourhood may be more appropriate.

For the purpose of this thesis, nine neighbourhoods were used to examine neighbourhood resource quality. The neighbourhoods were selected in ArcGIS on the basis of meshblock deprivation as a meshblock was used as an initial starting point from which to define a neighbourhood area. To do this, a shape file containing the 2887 Christchurch meshblocks was added as a layer in ArcMap. A meshblock is a geographical unit defined by Statistics New Zealand and is the smallest unit of census data, with each area representing approximately 100 people (Statistics New Zealand 2006). The deprivation of each meshblock is determined based on the New Zealand Index of Deprivation 2006 (NZDep06). The NZDep06 is a measure of material and social deprivation which reflects lacks of income, employment, communication, transport, support, qualifications and owned home (Salmond et al. 2007). The ten deprivation deciles were collapsed into quintiles with quintile one representing low deprivation and quintile five representing high deprivation.

To examine how resource quality varies between neighbourhoods of different social deprivation, the study focused on three deprivation quintile categories: low, medium and high (Quintiles 1, 3 and 5).

To choose the neighbourhoods, all meshblocks with a deprivation score within the three quintile categories were selected and exported as a separate layer. From this, three meshblocks were randomly selected from each quintile category using Hawth's Sampling Tools, resulting in nine meshblocks. These meshblocks were the initial point from which the neighbourhood would be defined. In these meshblocks, the population weighted centroid (PWC) was inserted into the meshblock to determine the point from which the three neighbourhood buffers would be measured from. The PWC of each meshblock was used to represent the centre of population of each neighbourhood rather than the geometric centre because in larger rural meshblocks the geometric centre is often positioned a considerable distance away from the centre of population.

Using the PWC of each selected meshblock, an 800 metre, 1 kilometre and 1.2 kilometre Euclidean buffer was inserted to signify the neighbourhood area (Figure 3.1). The deprivation of the wider neighbourhood area often differs from the deprivation of the original chosen meshblock. This is because the neighbourhood area contains a number of meshblocks of different deprivations of which the chosen meshblock is only one of these. Chapter Four outlines the differences between the meshblock deprivation and the overall deprivation of the neighbourhood. As a meshblock was only used as an initial selection point for the neighbourhoods, the definition of a neighbourhood as the area within a buffered zone and the overall deprivation of the wider neighbourhood area will be used for the remainder of this thesis. Using the deprivation of the wider

neighbourhood area resulted in two neighbourhoods categorised as low deprivation, four as medium deprivation and three as high deprivation. A table and map of the nine selected neighbourhoods is presented in the following chapter.

Defining the neighborhood as the area within the boundary of a circle has several advantages. First, it captures all areas to which a resident may be exposed on a daily basis during both foot and automobile travels. Also, the straight line distance allows for capture of distance traveled on footpaths and other "short cut" routes that may not be captured by using a street network strategy (Lee et al. 2000). Finally, it allows examination of the availability and quality of resources within a wider neighbourhood area.

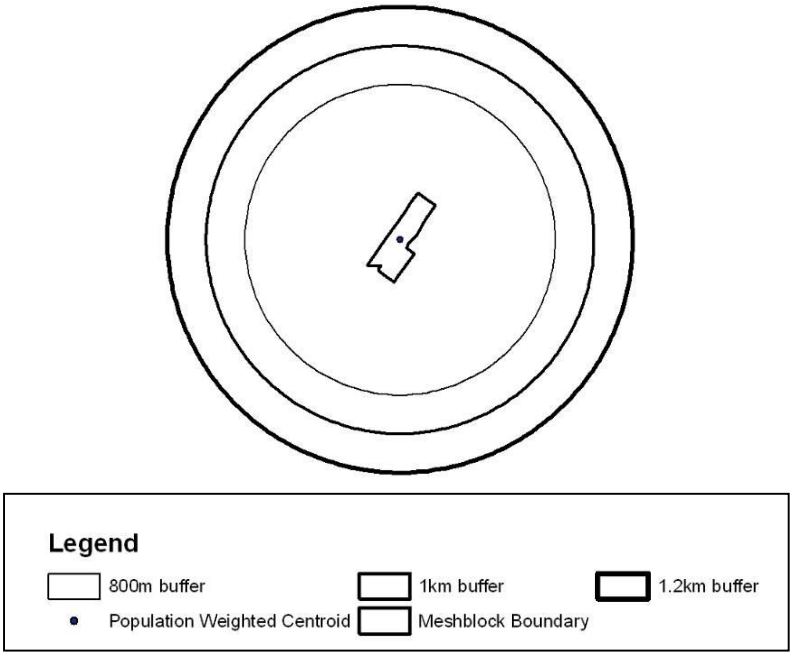

Figure 3.1: Schematic diagram of the buffer analysis procedure

Once the nine neighbourhoods had been selected, the local neighbourhood resources that may influence physical activity and food consumption were added as separate

layers into ArcGIS to illustrate the abundance and location of resources in each neighbourhood.

To examine whether there was any significant relationship between the overall count of resources and deprivation category, a chi square test was undertaken using the methods outlined by Blalock (1972). A count of resources is used as it examines differential access to resources determined by bureaucratic rules and employed by urban planners. The simplest way to determine accessibility is to note the number of resources within an area (Pinch 1985). All local resources within each neighbourhood deprivation were amalgamated into three categories; parks, and healthy and unhealthy food resources. The chi square value was then calculated manually to examine whether a significant relationship existed at the 0.05 or 0.01 level. Separate chi square tests were also conducted examining the relationship between deprivation, parks and sports facilities, and deprivation and healthy and unhealthy food resources. The results of these tests are presented in Chapter Five.

3.3.2 Analysis Used to Determine the Extent of Variation in Resource Quality between Neighbourhoods of Differing Deprivation

In order to understand whether the quality of resources varies between neighbourhoods of different degrees of social deprivation, a tool was developed to systematically survey the neighbourhoods (Appendix 1). At present there is no widely accepted system or protocol for describing or evaluating features in the environment. The site survey tool developed for this study provides a comprehensive instrument that allows observers to characterise the physical environments in their neighbourhood. By developing an instrument that examines the quality of a certain neighbourhood feature, environments can be assessed and modified so that they may reduce the prevalence of obesity in the

area and provide higher quality resources for residents. This tool was based in part on other assessment tools used to systematize observations in the field such as the 'BESS' checklist (Weich et al. 2001), the 'EAPRS' tool (Saelens et al. 2006), the 'PARA' instrument (Lee et al. 2005) and the Urban Park Assessment tool (Coen and Ross 2006).

The development of the tool used associations made in the literature between the built environment and obesity to create a 62 question checklist. The tool assessed seven categories of the built environment. These were: Urban Sprawl, Road Connectivity, Walkability, Mixed Landuse, Food Resources, Green Space and Crime and Safety. Each of the nine neighbourhoods selected in this study were visited on a weekday at approximately the same time and during the same weather conditions. This allowed for consistency between the neighbourhoods, especially in regards to questions regarding utilisation of resources as bad weather conditions can influence whether a resource is utilised or not. Every street within the designated neighbourhood area was walked to examine the overall quality of the neighbourhood. This was a process that took at least two hours per neighbourhood.

Each neighbourhood was assessed based on the seven categories mentioned above using the site survey tool developed for this study. Crime within a neighbourhood was assessed using the presence of incivilities such as graffiti, vandalism, litter etc. This was used as research has suggested that a high level of incivilities in a neighbourhood can be an indicator and influence of criminal behaviour within a neighbourhood (Doeksen 1997, Ellaway et al. 2005). Each neighbourhood feature was rated one of two ways. The simplest assessment was based on the presence or absence of a feature. For example, when examining green space, the tool asked whether there was a sports field

in the neighbourhood or not. If the answer was yes, further questions were answered to establish the quality of the sports field and the features it provided.

Once the presence or absence of a feature had been established, a three category quantitative system was used to establish the quality. Ratings were listed as “poor”, “adequate” or “excellent”, with specific definitions developed for each category. Definitions of the quality of resources were based on categories used in previous research which has utlised site survey tools (Weich et al. 2001, Lee et al. 2005). These definitions had been tested through extensive pilot studies and reliability tests to ensure that they accurately represented a certain quality feature. For example, a sports field’s rating as a high quality resource was defined as “a facility that provides an area for more than one sport to be played, where ground surface has even grass coverage that is mown with no opportunity to twist ankles, bathroom facilities have been provided that are in an sanitary condition, the area is well lit, has been landscaped to provide an aesthetically pleasing area to visit, and both seating and rubbish bins have been provided for spectators.” Photographs were taken while conducting the assessment to provide a visual record of each neighbourhood for future reference.

Once a neighbourhood had been evaluated, the questions were manually coded using a binary system to examine the quality of each built environment feature that influences obesity. Questions examining the presence or absence of a feature were given a score of 0 or 1. For questions using the three category quantitative system, a poor quality rating was given a 0, adequate a 1 and an excellent feature a score of 2.

An examination of the literature shows that not all features of the built environment are as significant in influencing the obesity levels within a neighbourhood. As well as this, the relationships are complex and require a number of different factors to be present before influencing obesity levels. The number of questions needed to examine the quality of the built environment and how in turn it influences obesity reflects this as more complex relationships require more questions to accurately assess the neighbourhood. As a result, the number of questions in each category could have an important influence on the final score of the neighbourhood as those which scored highly in a category with more questions could skew the results of the site surveys. For example, a neighbourhood could score a total possible score of 39 for green space, whereas for crime and safety only a total of 12. This meant that neighbourhoods which scored highly in the green space category may have a higher final score and be judged as a neighbourhood with better resources than neighbourhoods which scored lower.

To prevent this from happening, and to allow comparison between the neighbourhoods, all neighbourhoods needed to have a common total score. To achieve this, the categories were ranked according to the relative importance the literature attributed to their influence on obesity. The rankings were based on the most commonly accepted relationships between obesity and the built environment and followed a similar method to that of Witten et al. (2003).

The following method was used to weight the categories. For example, if green space is ranked as one of the most important influences on obesity, it would be given a weighting of 5. If one of the neighbourhoods had a raw score of 34/41, this raw score would be multiplied by the category weighting (5) to get a weighted score of 4.15 out of

a total 5 points. The weighted scores from each category were then added to create a final weighted score out of 24 (the sum of all the weightings), allowing the neighbourhoods to be compared regardless of the number of resources they had. While an extensive amount of literature was consulted to carefully determine the weightings given to the seven categories, a subjective decision regarding the weighting had to be made. After an extensive search of the literature, relationships with a greater influence on obesity were given a higher rating (Table 3.2). One limitation in using this method is the uncertainty within the literature regarding the influence these seven factors have on obesity as results from the literature are influenced by both study site and the method used.

As a result, to test the sensitivity of the chosen weightings, the categories were ranked and weighted multiple times to examine how the final weighted score of a neighbourhood varied with different weightings. As the final weighted scores of the neighbourhood only decreased by 1% overall, it was deemed that these rankings were not very sensitive to changes. Consequently, the rankings and weightings outlined in Table 3.2 will be used for the remainder of this thesis.

The final weighted scores of each neighbourhood were then converted into percentages with 100% indicating a high quality environment that may reduce the likelihood of obesity and 0% a low quality environment that encourages obesity. These percentages were converted into a column graph in Microsoft Excel to visually examine how the quality of neighbourhood environments varies between neighbourhoods. As the aim of this thesis is also to examine how overall deprivation influences the quality of a neighbourhood, the averaged scores from each deprivation quintile were also graphed in

Microsoft Excel. This was achieved by adding the final scores of all the neighbourhoods in one deprivation group and dividing this score by the number of neighbourhoods in that group. This new score was then divided by 24 for a final averaged neighbourhood deprivation score. The results of this process are presented in the next chapter.

Category	Rank	Weight	Reason	Author
Green Space/ Physical Activity	1	5	For respondents whose residential environment contains high levels of greenery, the likelihood of being more physically active is more than three times as high, and the likelihood of being overweight and obese is about 40% less	Ellaway et al. (2005)
Food Environment	1	5	Exposure to poor quality food environments amplifies individual risk factors for obesity	Cummins and Macintyre (2006)
Crime and Safety	2	4	45% of people living in deprived areas compared to 4% of those in more affluent areas reported a problem with the availability of safe places for children to play	Curtice et al. (2005)
Urban Sprawl	3	3	Time spent in the car as a passenger or driver was positively associated with obesity, and an additional 60 minutes per day in the car translated into an additional 6% odds of being obese	Frank et al. (2004)
Walkability	3	3	Residents of neighbourhoods with higher population density, proximity to commercial destinations, and good public transportation are more physically active than residents of less walkable neighbourhoods often deemed ‘‘suburban’’	Frank et al. (2005)
Mixed Landuse	4	2	Neighborhoods where houses are mixed with a variety of local grocery stores and other shops may encourage people to walk more and eat healthier food than those where all land is devoted to housing.	Eid et al. (2008)
Road Connectivity	4	2	Mean BMI for white males decreased significantly as mix, density, and connectivity increased	Frank et al. (2004)
Total		24		

Table 3.2: Table showing the ranking and weighting of the built environment categories influencing obesity according to the most commonly accepted relationships within the literature

3.3.3 Analysis Used to Test the Objectivity of the Site Survey Tool

The creation of a site survey tool based on relationships determined by the literature has one obvious limitation in that decisions made in the field regarding the quality of the neighbourhood are largely subjective as they are individual level assessments made by a single observer. In order to validate the use of a systematic site survey, three objective measures were employed to compare to the findings of the survey tool. These objective measures are indicators that can be characterised as being independent of an observer's own perception. Should the objective measures show similar results and relationships to those found by the site survey tool, we can assume that the site survey tool has correctly identified the relationships. These objective measures tested the connectivity of the neighbourhood bus system, the accessibility of green space, and the walkability of a neighbourhood.

3.3.3.1 Neighbourhood Connectivity

The original file received from SHORE (Table 3.1) contained all bus shelters, stops and bus routes throughout Christchurch. As this thesis only examined nine neighbourhoods, the data were clipped using the extract tool in ArcToolbox to include only the points/routes within the buffered neighbourhood areas. Using Hawth's Analysis Tools, a program designed to perform spatial analysis that cannot be conveniently accomplished with out-of-the box ArcGIS, the total number of points within the neighbourhood buffer area could be counted for each neighbourhood. This analysis was based on the assumption that the more bus shelters and stops a neighbourhood had, the greater access people had to a bus system and more connected it was to the rest of Christchurch. To test the connectivity of the bus routes in each of the neighbourhoods, Hawth's Analysis tools was used again to sum the total lengths of bus route lines within

the neighbourhood. Similarly, the greater the bus route length, the more connected the neighbourhood is as there are more areas the bus travels to, and more potential access points to other surrounding neighbourhoods.

In Microsoft Excel, the number of bus shelters and bus stops were counted for each buffered neighbourhood. These figures were then averaged according to overall neighbourhood deprivation. This was done by adding the totals of bus stops and shelters for the neighbourhoods belonging to one deprivation category (eg. adding the total bus shelters for the three high deprivation neighbourhoods) and dividing this total by the number of neighbourhoods in that deprivation category. The deprivation category with the highest averaged total was deemed to be the most connected. A similar method was used for determining bus routes. The total length of bus route in metres within the neighbourhood buffer area was added into Excel. The total bus route lengths for the three neighbourhoods in a deprivation category were then divided to find the average bus length in a certain deprivation environment. The results of this objective measure are presented in the following chapter.

3.3.3.2 Accessibility of Green Space

The second objective measure used to test the findings of the site survey is accessible green space. The term accessible green space refers to areas which can be readily accessed and used by the public. This is different to green space in general as there are certain areas of green space that are not open to the public for everyday use such as sanctuaries, nature reserves and racecourses. Using the datasets provided by the Department of Conservation, Land and Income New Zealand and Water Safety New Zealand, a new layer of accessible green space was added into ArcGIS. If any part of a

green space area was encompassed by the 800 metre neighbourhood buffer it was deemed as accessible for that neighbourhood. This included areas of green space that for the most part were located outside of the neighbourhood area, but that had a small section included in the neighbourhood boundary as individuals will not stop using the area solely because an arbitrary buffer determines that it is not in their neighbourhood.

The area of each section of green space was calculated using the measure tool in ArcMap. This included calculating the area of the green space that was not contained within the 800 metre neighbourhood area. To determine the percentage of green space within a neighbourhood, the total green space was divided by the total neighbourhood area. The total neighbourhood area was defined as the total area within the neighbourhood buffer plus the area of any green space for which part of that green space was inside the buffer. The average accessible green space was then calculated for each deprivation quintile. This was done by adding the total percentage of each neighbourhood within a single deprivation category and dividing by the number of neighbourhoods in that category. The neighbourhood deprivation category with the highest average percentage was deemed to have the most accessible green space.

3.3.3.3 Walkability of the Neighbourhood

Finally, the walkability of a neighbourhood is an important measure as an attractive physical environment can encourage individuals to walk for both leisure and transport within their neighbourhood. A walking network within a neighbourhood differs from a road network as it allows analysis to include real world scenarios where pedestrians are likely to use links that are not alongside roads. This includes walking paths through conservation areas, parks, schools and other off road short cuts frequently taken by

pedestrians. As a result, the more walkable paths an individual has, may lead in an increase in walking for both recreational and transportation purposes as they have more varied and interesting places to walk to. To test the walkability of the neighbourhood, Hawth's Analysis tools were once again used in ArcMap to sum the total lengths in metres of walkable paths available. This was based on an individual being able to walk on both sides of a road. The total length of walkable footpath within the equivalent deprivation neighbourhoods were added and then divided by the total number of neighbourhoods in that deprivation category to determine the average length of walkable footpath within a low, medium or high deprivation environment.

A second approach to investigate how walkable a neighbourhood is looked at the safety of individuals walking by examining the types of roads within the neighbourhoods. A hierarchy of roads exist in each neighbourhood ranging from a high capacity arterial road to a minor local or private road. The number of each type of road can determine how safe it is for an individual to walk within a neighbourhood as higher traffic roads may make walking unsafe. Neighbourhoods with higher numbers of arterial and collector roads were more unsafe as these roads regularly carry large volumes of traffic.

To determine whether one neighbourhood is safer to walk in than another, four categories of road were used: private roads, local roads, collector roads and arterial roads (both major and minor). This was calculated using the Christchurch road network which contains a list of every road within Christchurch and its classification. The number of each classification of road within a neighbourhood and the total number of roads was calculated for each of the nine neighbourhoods. To calculate the percentage of each type of road classification within the neighbourhood, the number of a certain

road type was divided by the total number of roads within that neighbourhood. Conclusions could then be drawn regarding both the neighbourhood and the overall deprivation safest for pedestrians.

Regardless of the quality of a neighbourhood, either subjectively or objectively determined, the perception of the environment by neighbourhood residents can have a large influence on whether obesity promoting or reducing resources are utilised. The methodology used to determine how individuals perceive their environment and how this influences resource utilisation is the subject of the next section of this chapter.

3.3.4 Analysis Used to Determine How Individual Perception Influences Resource Utilisation within a Neighbourhood

The aim of this section is to examine whether local residents' perception of their surrounding neighbourhood varies compared to the resources actually located within the neighbourhood. The reason for this being that an individual's perception as to whether a resource exists in their neighbourhood or if it is safe to use may have a large influence on their utilisation of those resources regardless of the overall quality of the resource itself. To examine this, a questionnaire tool was developed to help understand residents' perceptions of their environment. Full ethics approval was granted from the University of Canterbury Ethics Committee in May 2008.

A pilot study was conducted in a deprivation quintile 4 neighbourhood. This process recruited 20 participants through door knocking to ensure the questions were easily understandable and obtain the desired information from participants. Residents were approached during different days of the week and weekends to ensure bias was reduced by including a number of participants of different ages, sex and socioeconomic status.

As a result of this pilot study, some questions were altered for the final survey to allow better understanding by participants in the surveyed neighbourhoods. These included adding a question about the use of indoor facilities such as gyms for physical activity. A question regarding the safety of walking in the neighbourhood alone was split into both day and night after some participants commented that they would walk through their neighbourhood alone during the day but never at night.

While the results of the site survey examined nine neighbourhoods throughout Christchurch, the perception questionnaires were only conducted in three neighbourhoods. One neighbourhood from each neighbourhood deprivation category (low, medium, high deprivation) was chosen to be examined using the questionnaire process. The most deprived neighbourhood was not chosen to participate in the questionnaire process as the safety of distributing questionnaires within this neighbourhood was questionable. A total of 90 participants were recruited to participate through the process of door knocking as this often has a higher response rate than sending questionnaires in the mail. Recruitment of the required number of participants took up to 8.5 hours with participation rates up to 57%.

The low deprivation Aorangi neighbourhood had the lowest questionnaire participation rates of all three neighbourhoods, taking up to 8.5 hours to recruit all 30 participants. A total of 56 houses were approached in this neighbourhood before the required number of participants were reached, resulting in a participation rate of 53%. The medium deprivation Islington neighbourhood had the highest participation rates with all 30 individuals, being recruited in only four hours. 52 individuals were approached in this neighbourhood, producing the highest response rate of all three neighbourhoods at 57%.

Finally, the high deprivation Opawa neighbourhood had similar participation rates to that of the low deprivation Aorangi rates. A total of 55 households were visited within a 6.5 hour period with a 54% response rate in this neighbourhood.

Each of the chosen neighbourhoods were visited various times throughout the weekend to ensure a greater sample of the population were available to participate. Participants were recruited as close as possible to the PWC of the original meshblock chosen as this was the centrepoint of the neighbourhood where participants would have most access to their surrounding resources. Given the usually low participation rates in questionnaires, some participants had to be recruited from the adjacent meshblocks included within the 800 metre neighbourhood area. A five-point Likert Scale questionnaire asked participants to rate their agreement from strongly agree (1) to strongly disagree (5). It included 22 questions about safety and crime, food establishments, and access to green space and physical activity within the neighbourhood (Table 3.3).

To determine whether perceptions of a neighbourhood can be influenced by neighbourhood deprivation a chi square test was undertaken for each of the questions asked of the participants. This involved combining the categories to create a three by three table of low medium and high deprivation versus the count of participants who were neutral, agreed or disagreed with a statement. A significant result at the 0.05 or 0.01 level means that the null hypothesis is rejected and that the perception of that specific question is patterned by deprivation.

The population characteristics of the three neighbourhoods investigated were broken down by age, sex, education and income in order to examine the composition of

individuals who reside in certain deprivation neighbourhoods. This examined the percentage of the participating population identifying with a social characteristic. For example, the percentage of the population who had a certain level of education examines the different education levels and the most common education level achieved for both males and females compared to the other deprivation neighbourhoods.

The perception of the time it takes for an individual to reach a resource can have an important influence on their utilisation as resources closer to an individual's home are more likely to be used than those further away. To examine the accuracy of perceived walking travel times to a neighbourhood resource compared to actual walking travel times, the travel time taken to the nearest food resource along the road network was calculated using ArcGIS. This was based on the assumption that an individual can walk approximately five kilometres per hour (Walton and Sunseri 2007). From this, a distance of 500 metres would take the average individual approximately 6 minutes to walk. Using the PWC of the meshblock as a starting point, the distance was measured following the road network to the closest food resource in the neighbourhood. This actual distance was then converted to a time and compared to the participants' answers for each resource in each neighbourhood.

Once all questionnaires were completed in a neighbourhood, they were entered into a table in Microsoft Word to examine the differing perceptions about neighbourhood resources. The responses of participants in each neighbourhood for each question were grouped together (Table 3.4) so that participant responses could be easily compared to examine how residents' perception of their neighbourhood varies and how this may influence their utilisation of resources.

	S.Agree				S.Disagree
1. I am satisfied with the area I live in	1	2	3	4	5
2. My neighbourhood offers many opportunities to be active	1	2	3	4	5
3. There are playgrounds, parks or beaches close by that I can walk to	1	2	3	4	5
4. I regularly visit parks or playgrounds for physical activity	1	2	3	4	5
5. Having a park or areas of physical activity in my neighbourhood is important to me	1	2	3	4	5
6. I prefer to get my physical activity indoors (eg gym facilities etc)	1	2	3	4	5
7. There are bicycle or pedestrian trails in or near my neighbourhood that are easy to get to	1	2	3	4	5
8. The neighbourhood is safe for walking during the day	1	2	3	4	5
9. The neighbourhood is safe for walking during the night	1	2	3	4	5
10. Neighbourhood traffic in the area makes physical activity unsafe	1	2	3	4	5
11. My neighbourhood streets are well lit	1	2	3	4	5
12. Letting children play outside in my neighbourhood is dangerous	1	2	3	4	5
13. Letting children play in the playground unsupervised is safe	1	2	3	4	5
14. I don't exercise in my neighbourhood because I am worried about my safety	1	2	3	4	5
15. I often shop at local grocery stores/dairies for my food rather than going to a supermarket	1	2	3	4	5
16. Shops are within easy walking distance of my home	1	2	3	4	5
17. There are lots of healthy options for eating out in my local neighbourhood	1	2	3	4	5
18. How long would it take to get from your home to the nearest business or facility if you walked to it:					
small grocery/convenience store	<5 mins	5-10 mins	10-20 mins	30+	mins
Supermarket	<5 mins	5-10 mins	10-20 mins	30+	mins
Fast food restaurant (McDonalds etc)	<5 mins	5-10 mins	10-20 mins	30+	mins
Non-fast food restaurant (eat-in dining)	<5 mins	5-10 mins	10-20 mins	30+	mins
Takeaway outlet (Fish and Chips)	<5 mins	5-10 mins	10-20 mins	30+ mins	
19. I have access to a specialty store (fruit and vegetable/butchers etc) in my neighbourhood	1	2	3	4	5
20. There are many fast food restaurants in my neighbourhood	1	2	3	4	5
21. It is difficult to eat healthy because healthy food options are often limited	1	2	3	4	5
22. Sometimes my household can not afford to buy healthy and nutritious food	1	2	3	4	5

Table 3.3: The questions used in the Likert Scale Questionnaire to explore the perceptions of neighbourhood residents

Response to the question: I am satisfied with the area I live in					
Neighbourhood Deprivation	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Low	37%	**50%**	10%	3%	0%
Medium	**50%**	33%	7%	10%	0%
High	**80%**	13%	7%	0%	0%

Table 3.4: Example of the format of the perception results table to examine how perceptions vary for each question

The results of these questionnaires are broken down into three categories; food environment, physical activity and crime and safety, and are presented in Chapter Six.

3.4 Conclusion

This chapter has discussed the methods used in this research to achieve the two aims set out in Chapter One. These aims are to investigate how neighbourhood deprivation influences the quality of built environment features and how these neighbourhoods may promote an obesogenic environment. It also attempts to understand how perceptions of a neighbourhood can influence dietary and physical activity behaviour. The first section of this chapter focused the data sources used in this thesis. The subsequent sections explored in detail the methods used to answer the two objectives. The chapters that follow first outline the characteristics of the neighbourhoods selected and focus on the results found in this study. These results can be considered in light of the methods adopted for this research.

Chapter Four
The Neighbourhoods

4.1 Introduction

The purpose of this chapter is to introduce the nine neighbourhoods selected for this research and illustrate the location of resources that may influence obesity within each area. This chapter provides the context of the neighbourhoods. It outlines the locations and availability of built environment resources and will present the population characteristics of each of the three neighbourhoods involved in the questionnaire process to provide a snapshot of the variety of individuals living within a certain deprivation category.

4.2 The Neighbourhoods

The characteristics of each neighbourhood are presented in Table 4.1. The table presents the characteristics of each of the original meshblocks used to select the neighbourhood. More importantly, the table outlines the deprivation quintile of each of the nine neighbourhood areas. The table shows that the three meshblock deprivation quintiles correspond fairly closely to that of the wider neighbourhood deprivation quintiles. The range of deprivation within the neighbourhood measures the homogeneity within a neighbourhood zone. A low range of deprivation categories indicates that the neighbourhood is fairly homogenous whereas a high range indicates that the neighbourhood deprivations are spread out over a wide range of values.

Neighbourhood	Meshblock Deprivation Quintile	Median Neighbourhood Deprivation Quintile	Range of Deprivation Deciles	Census Area Unit	Meshblock	Meshblock Population
Avon Heathcote	(1) Low	1 (lowest)	1-5	596000	2699500	66
Aorangi		2 (low)	2-10	592000	2666100	177
Edgeware		3 (medium)	1-10	592600	2695900	120
Barrington North	(3) Medium	3 (medium)	1-10	594800	2640500	117
Islington		3 (medium)	3-9	587830	2498100	189
St Albans		3 (medium)	4-10	592402	2687100	39
Opawa	(5) High	4 (high)	1-10	594300	2585900	159
Avonside		4 (high)	3-10	593400	2613900	114
Aranui		5 (highest)	6-10	593100	2573000	53

Table 4.1: Table of the characteristics of the nine neighbourhoods (based on an 800 metre buffer) analysed in this thesis

The table indicates that overall, the neighbourhoods contain a wide range of meshblocks. The Avon Heathcote and Aranui neighbourhoods are the most homogenous of all the neighbourhoods. The Avon Heathcote neighbourhood contains meshblocks of very low to medium deprivation while the Aranui neighbourhood contains medium to very high deprivation meshblocks. This can influence the population characteristics of the neighbourhood and potentially create segregated communities of high or low deprivation individuals. Figure 4.1 illustrates the location of the nine randomly selected neighbourhoods within Christchurch and deprivation quintile category of the wider neighbourhood

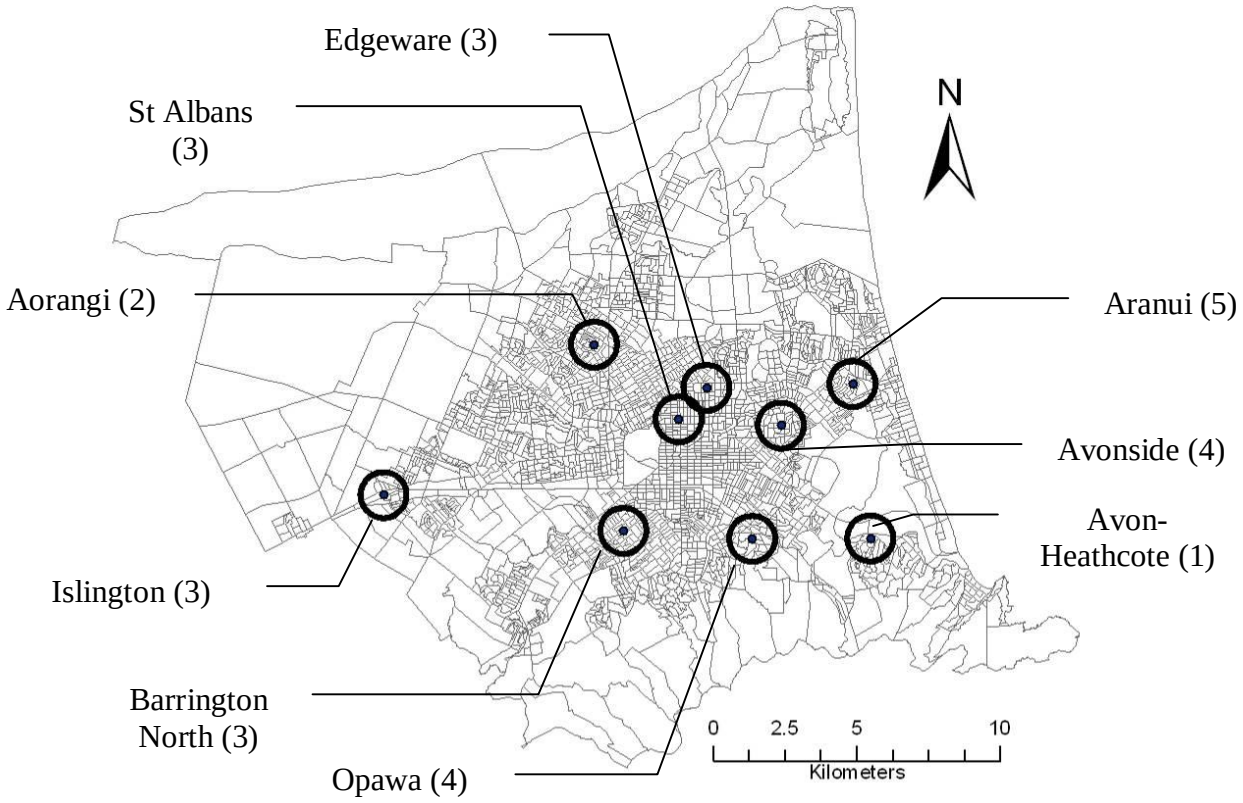

Figure 4.1: Randomly selected neighbourhoods within Christchurch with an 800m Euclidean buffer showing the extent of the neighbourhoods surveyed and their corresponding neighbourhood deprivation quintile

4.3 Local Neighbourhood Resources

The location of resources within a neighbourhood can have an important influence on increasing or reducing obesity. A neighbourhood with an abundance of resources promoting physical activity or healthy consumption patterns may be more likely to decrease obesity compared to a neighbourhood with few or low quality resources. The following section profiles the nine neighbourhoods stratified by wider neighbourhood deprivation (Figures 4.2-4.4). A total count of each resource available within a neighbourhood is also provided (Table 4.2). A complete dissection of each neighbourhood is available in Appendix 2.

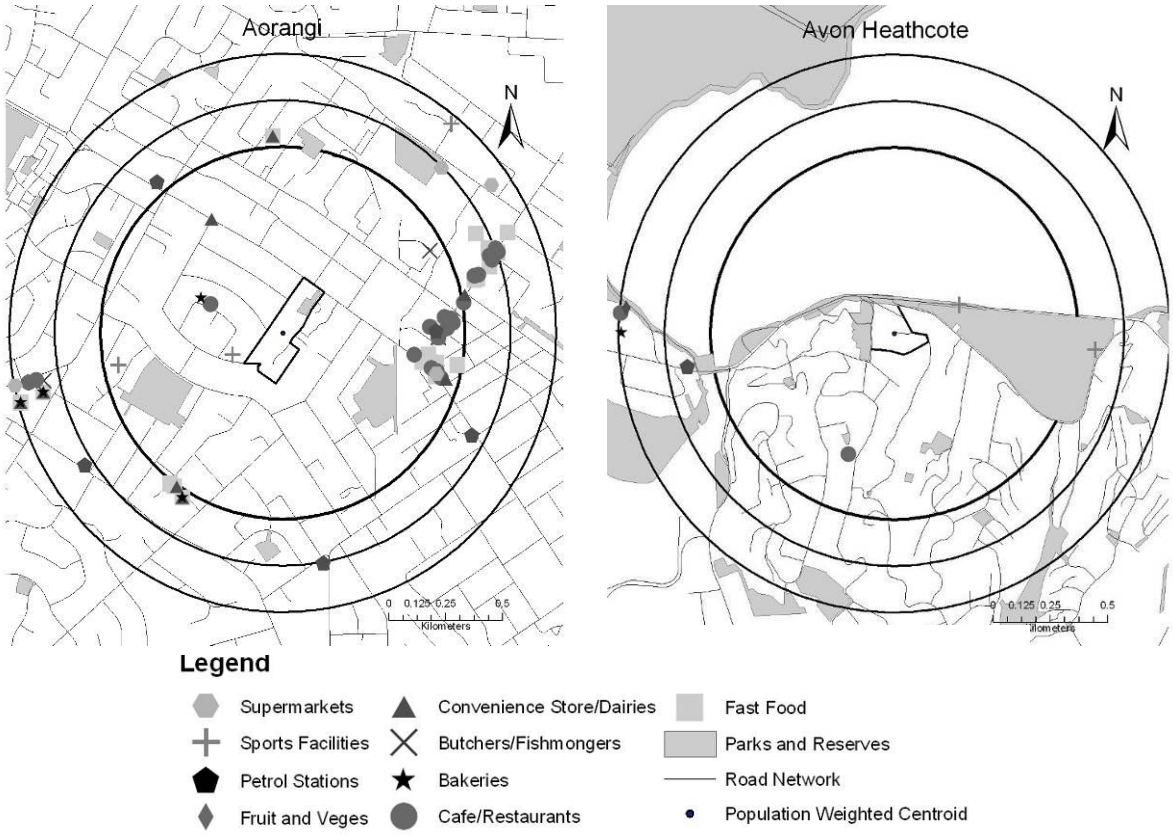

Figure 4.2: Spatial placement of resources in the low deprivation neighbourhoods of Aorangi and Avon Heathcote. The highlighted meshblock is the original randomly selected meshblock and the centre point of the neighbourhood

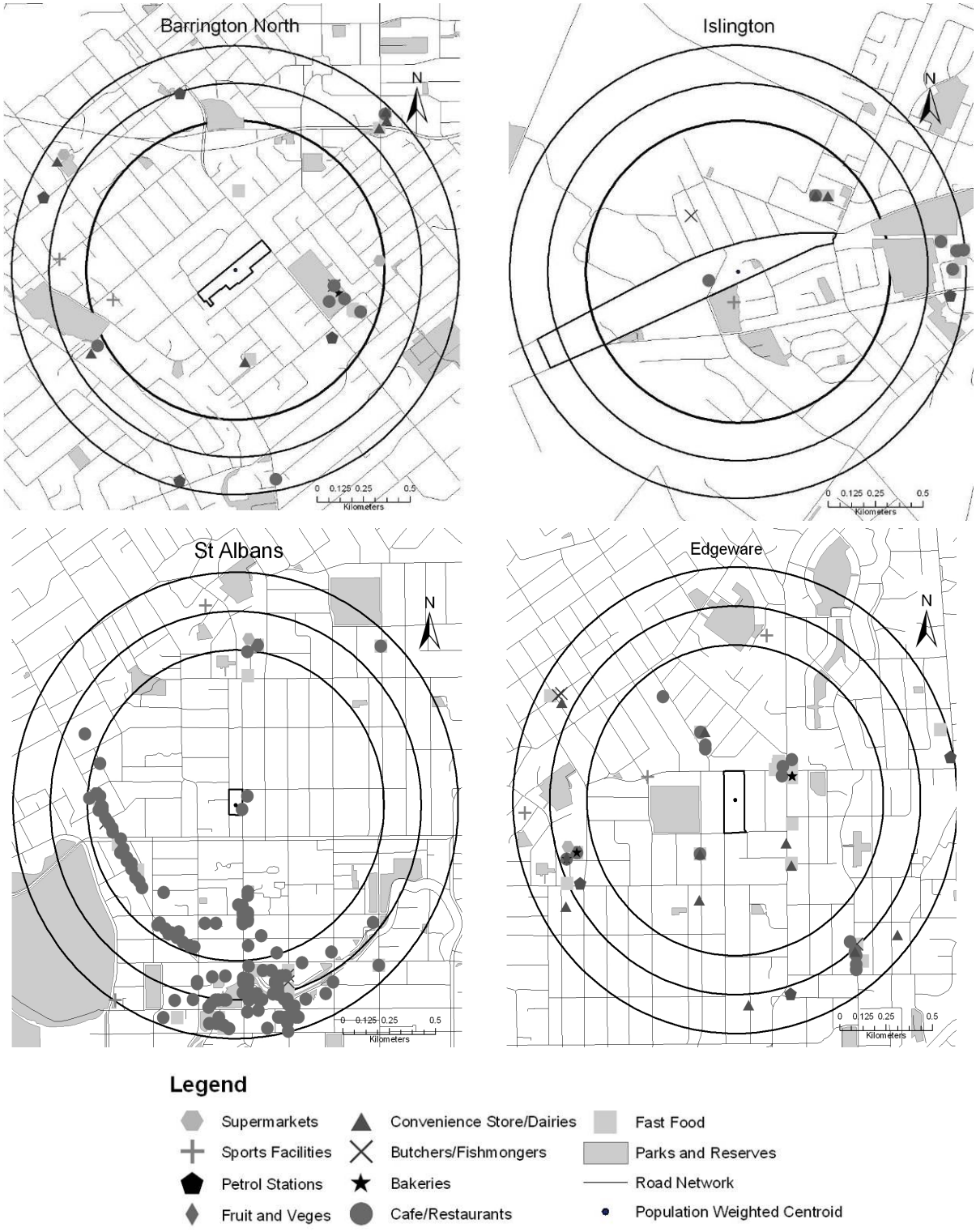

Figure 4.3: Spatial placement of resources in the medium deprivation neighbourhoods of Barrington North, Islington, St Albans and Edgeware. The highlighted meshblock is the original randomly selected meshblock and the centre point of the neighbourhood

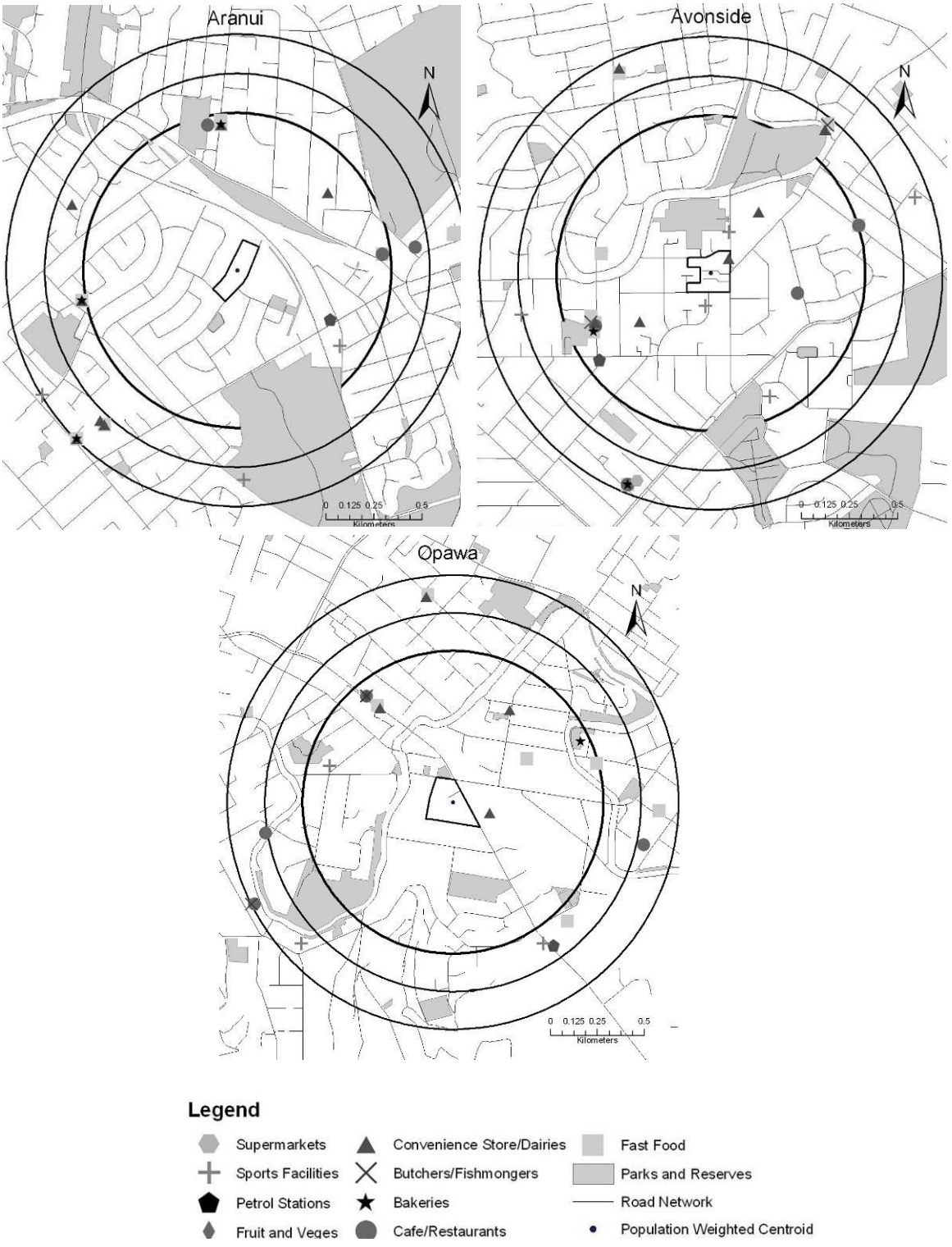

Figure 4.4: Spatial placement of resources in the high deprivation neighbourhoods of Aranui, Avonside and Opawa. The highlighted meshblock is the original randomly selected meshblock and the centre point of the neighbourhood

	Deprivation Category	Public Parks	Sports Facility	Super market	Petrol Station	Fast Food	Restaurant Café	Convenience Store/Dairy	Fruit & Veges	Butcher/ Fishmonger	Bakery
Avon Heathcote	Low	10	1	0	0	0	1	0	0	0	0
Aorangi		5	2	1	1	8	14	3	0	2	1
Edgeware	Medium	8	1	0	0	8	8	5	0	0	2
Barrington North		7	1	1	1	7	4	1	0	1	2
Islington		8	1	0	0	2	2	2	0	1	0
St Albans		6	0	0	3	5	58	7	2	1	2
Opawa	High	7	1	0	0	3	1	3	1	1	1
Avonside		6	3	0	1	4	2	4	0	1	1
Aranui		5	1	0	1	4	2	2	0	0	1

Table 4.2: Comparison table of the count of local resources within the 800 metre buffer of each neighbourhood

Table 4.2 illustrates that the medium deprivation St Albans neighbourhood provides the largest variety of resources within a neighbourhood, and the Avon Heathcote the least. While all the neighbourhoods examined in this thesis vary in terms of the total number of resources they provide, there are a few common themes extending through all the neighbourhoods. These will be discussed in the following chapter.

4.4 Unique Neighbourhood Features

This section presents some of the photographs taken while surveying the neighbourhoods. These photographs depict various land use that can influence the likelihood of individuals engaging in physical activity within their neighbourhoods. The medium deprivation Islington neighbourhood is one of the best examples of land use that can have potentially damaging health effects. Located in the neighbourhood, surrounded by residential housing and just down the road from a local children's playground is the Moffett Street substation (Figure 4.5). As well as this, a large electricity switching station for the local area is located across a field from the same playground (Figure 4.6).

The visibility of industry within a neighbourhood can also be stratified on the basis of neighbourhood deprivation. On the opposite side of the neighbourhood to the Moffett Street substation is Kyle Park. While this is a very high quality green space area which includes a BMX track, sports field and even its own landscaped wetlands (Figure 4.7), the presence of industry is not far away as immediately adjacent to the park are a number of cold storage facilities (Figure 4.8) and a busy railway network.

The industry within the high deprivation neighbourhood of Opawa may be slightly more detrimental to individual health. Not only does this neighbourhood have a number of heavy traffic arterial roads through the centre of it increasing the amount of air pollution from large trucks, its skyline is also dominated by a number of smokestacks located throughout the residential area (Figure 4.9). The implications of having such structures located within a neighbourhood will be discussed in Chapter Nine.

Figure 4.5: Moffett Street substation in the middle of the Islington neighbourhood

Figure 4.6: Islington switching station adjacent to Moffett Street Playground

Figure 4.7: Landscaping at Kyle Park, Islington. In the background is the sports field and BMX track. To the right of the photo is a man-made lake

Figure 4.8: Cold storage facilities located adjacent to Kyle Street Park, Islington

Figure 4.9: Industry smokestacks among residential housing, Opawa

4.5 Neighbourhood Characteristics

Questionnaires were distributed in one neighbourhood of each deprivation category. These neighbourhoods were Aorangi (low deprivation), Islington (medium deprivation) and Opawa (high deprivation). The deprivation profile and population characteristics are presented by category for each neighbourhood in the following tables.

4.5.1 Deprivation Profiles of the three neighbourhoods

The deprivation of the wider neighbourhood area can be an important influence on resident's perceptions of the neighbourhood as it can impact on both the characteristics of individuals living in that neighbourhood and the types of resources available. Often, neighbourhood environments are not entirely homogenous and contain a wide variety of different deprivation meshblocks. The pattern was prevalent in all three of the neighbourhoods in which the questionnaire process was undertaken.

4.5.1.1 Aorangi

Figure 4.9 illustrates the varying deprivation of meshblocks within the Aorangi neighbourhood. This neighbourhood is predominantly low deprivation. However, there is some variation in the deprivation of other meshblocks within the neighbourhood. The most obvious division is through Harewood Road where the predominantly low deprivation meshblocks are separated from the high deprivation meshblocks. Many of these higher deprivation neighbourhoods contain housing estates which will influence certain characteristics of the population within this neighbourhood, particularly the age and household income. The advantage for these areas is that they receive access to certain resources such as gym facilities which would not typically be located in neighbourhoods of higher deprivation.

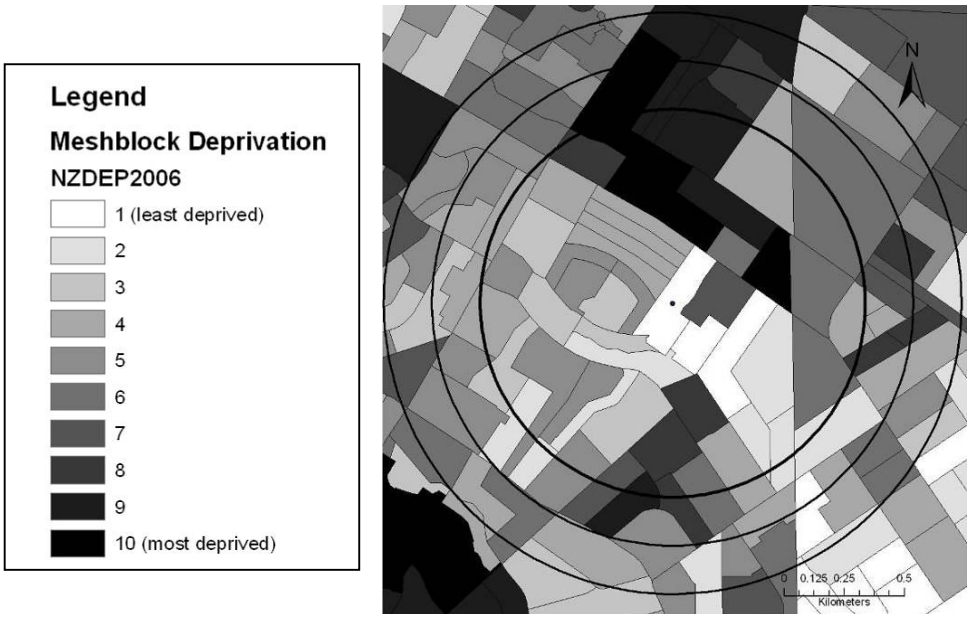

Figure 4.10: Variation of meshblocks within the Aorangi neighbourhood by deprivation

4.5.1.2 Islington

The majority of meshblocks within the neighbourhood of Islington are medium to high deprivation (Figure 4.10). In fact, the lowest deprivation meshblock within this

neighbourhood is a deprivation decile three, of which there is only one. The large industrial park located in this neighbourhood is spread over the upper left quadrant of the neighbourhood in an area primarily made up of deprivation six meshblocks. On the opposite side of the neighbourhood is most deprived portion of the neighbourhood. Figure 4.3 outlined the spatial placement of built environment resources available in the Islington neighbourhood. It is important to note that many of these resources are actually located within the higher deprivation area of the neighbourhood. Finally, the location of one of the neighbourhood's largest sports fields, Kyle Park, within this higher deprivation area is of special importance and will be examined further in later chapters.

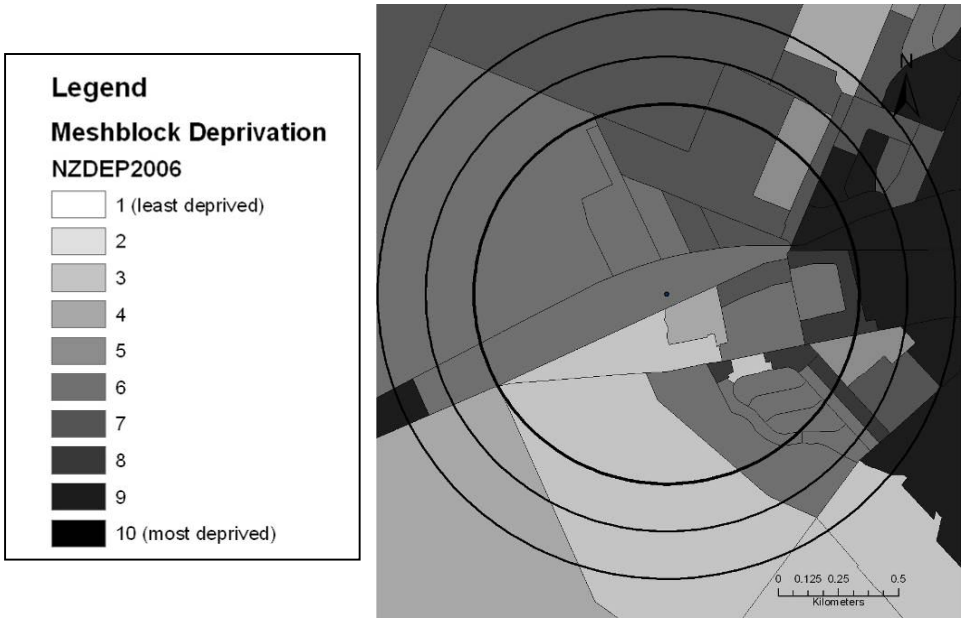

Figure 4.11: Variation of meshblocks within the Islington neighbourhood by deprivation

4.5.1.3 Opawa

Although the overall deprivation of the Opawa neighbourhood can be classified as high deprivation, this neighbourhood is the least homogenous of all three neighbourhoods involved in the questionnaire process as it contains the widest range of meshblocks

(Figure 4.11). While the neighbourhood was originally selected on the basis of containing a high deprivation meshblock, the wider neighbourhood area contains many meshblocks of lower deprivation. As a result, individuals living in this high deprivation meshblock area are exposed to resources more typical of a lower deprivation neighbourhood. Like Aorangi, the distribution of meshblock variation is separated by a road network with higher deprivation neighbourhoods located north of Brougham Street and lower deprivation meshblocks to the south. This can have a large influence on the population characteristics of individuals within the neighbourhood area.

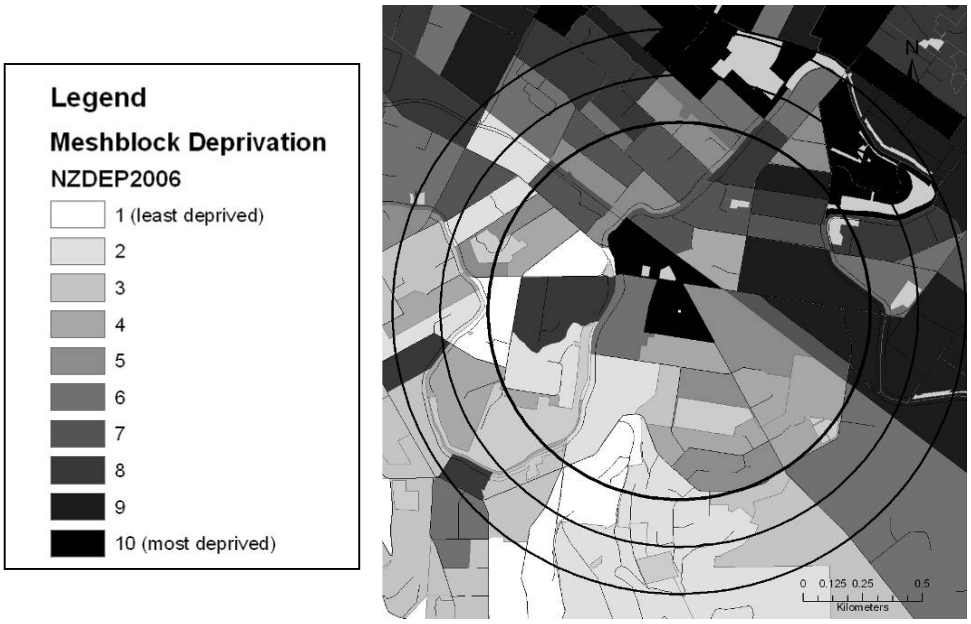

Figure 4.12: Variation of meshblocks within the Opawa neighbourhood by deprivation

4.5.2 Age and Sex

Table 4.3 outlines the age and sex characteristics of the participants within the three neighbourhoods. In the low deprivation Aorangi neighbourhood, of those individuals participating in the questionnaire process, 18 out of 30 participants were women and 12 were men. The majority of individuals willing to participate in the questionnaire process were aged between 40 to 49 years of age, with those 60 years and over being the

second most common. This was compared to the Islington neighbourhood where the median age for participants in this neighbourhood was between 40 and 49 years although participants over the age of 50 years old were more willing to participate in this neighbourhood than in the Aorangi neighbourhood. As with the previous neighbourhoods, in Opawa, females were more likely to agree to participate, with 23 of the 30 participants being women. The most common ages of participants in this neighbourhood are between 30 to 39 years and over 60 years of age. The three neighbourhoods demonstrate a slight relationship between deprivation and age of willing participants where as deprivation increases, the number of participants willing to participate in the questionnaire process who are aged below forty and above fifty years increases.

Age (Years)	**15- 19**	**20-29**	**30-39**	**40-49**	**50-59**	**60+**	**TOTAL**
Aorangi							
Male (12)	0%	8%	25%	25%	8%	33%	**100%**
Female (18)	0%	22%	22%	33%		22%	**100%**
TOTAL (30)	**0%**	**17%**	**23%**	**30%**	**3%**	**27%**	**100%**
Islington							
Male (13)	8%	23%	15%	15%	31%	8	**100%**
Female (17)	0%	6%	24%	35%	6%	29%	**100%**
TOTAL (30)	**3%**	**13%**	**20%**	**27%**	**17%**	**20%**	**100%**
Opawa							
Male (7)	0%	29%	14%	29%	29%	0%	**100%**
Female (23)	4%	4%	35%	17%	8%	30%	**100%**
TOTAL (30)	**3%**	**10%**	**30%**	**20%**	**13%**	**7%**	**100%**

Table 4.3: Table presenting the age characteristics of the respondents in each of the three neighbourhoods participating in the questionnaire process

4.5.3 Education

Table 4.4 presents the education characteristics of each neighbourhood. The highest average qualification reached in the Aorangi neighbourhood was New Zealand Higher School Certificate or New Zealand Bursary. Of the seven individuals who went on to further education, four graduated with an undergraduate degree and three went on to postgraduate study. Only four of the thirty participants had no formal qualifications.

This was compared to the Islington neighbourhood where the most common level of education achieved in this neighbourhood was between New Zealand School Certificate and New Zealand Sixth Form Certificate, or NCEA levels one and two as it has been called since 2004. Of those going on to further study, one female in this neighbourhood completed an undergraduate degree, and one male completed a postgraduate degree. A total of four participants in this neighbourhood had no formal qualifications.

Most surprising is the qualifications in the Opawa neighbourhood. This neighbourhood had the highest rates of university education with four individuals with undergraduate degrees and nine with postgraduate degrees. International literature shows a relationship between deprivation and education where individuals living in high deprivation areas often have lower education levels (Mujahid et al. 2008, Drewnowski 2004). This inconsistent finding is largely a reflection of the deprivation profile outlined in section 4.4.1.3 as this neighbourhood consists of a number of low deprivation meshblocks which would be expected to have higher education levels.

Education Category	1	2	3	4	5	6	7	TOTAL
Aorangi								
Male (12)	25%	8%	0%	8%	33%	17%	8%	**100%**
Female (18)	6%	11%	22%	17%	22%	11%	11%	**100%**
TOTAL (30)	**13%**	**10%**	**13%**	**13%**	**27%**	**13%**	**10%**	**100%**
Islington								
Male (13)	23%	0%	31%	31%	8%		8%	**100%**
Female (17)	6%	6%	29%	29%	24%	6%	0%	**100%**
TOTAL (30)	**13%**	**3%**	**30%**	**30%**	**17%**	**3%**	**3%**	**100%**
Opawa								
Male (7)	0%	14%	0%	43%	13%	14%	14%	**100%**
Female (23)	4%	8%	17%	4%	17%	13%	35%	**100%**
TOTAL (30)	**3%**	**10%**	**14%**	**13%**	**17%**	**13%**	**30%**	**100%**

1 – No qualifications 2 – Other eg Trade/Nursing 3 – NZ School Certificate/NCEA Level 1 4 – NZ Sixth Form Certificate/NCEA Level 2 5 – NZ Higher School Certificate/Bursary 6 – University Undergraduate Degree 7 – University Postgraduate Degree

Table 4.4: Table presenting the education characteristics of the respondents in each of the three neighbourhoods participating in the questionnaire process

4.5.4 Household Income

The average household income in New Zealand is $67,973 (Statistics New Zealand 2007). Table 4.5 presents the estimated household incomes for each of the three neighbourhoods. The majority of participants in all three neighbourhoods have an average household income of between $50,000 and $100,000. It is difficult to infer a relationship between deprivation and household income in these neighbourhoods as the study is dealing with very small numbers. Very tentatively as deprivation increases, the number of households earning above the national average increases with four households in Opawa, three in Islington and only two in Aorangi. The varying characteristics of these neighbourhoods may influence resident's perception of their own neighbourhood and as a result, their perception and utilisation of neighbourhood resources, and is the subject of the next section of this chapter.

Household Income	1	2	3	4	5	6	7	TOTAL
Aorangi								
Male (12)	0%	1%	0%	50%	25%	17%	0%	**100%**
Female (18)	17%	0%	6%	17%	56%	0%	6%	**100%**
TOTAL (30)	**10%**	**3%**	**3%**	**30%**	**43%**	**7%**	**3%**	**100%**
Islington								
Male (13)	8%	8%	8%	15%	38%	8%	15%	**100%**
Female (17)	12%	24%	12%	6%	35%	12%	0%	**100%**
TOTAL (30)	**10%**	**17%**	**10%**	**10%**	**37%**	**10%**	**7%**	**100%**
Opawa								
Male (7)	0%	14%	0%	29%	43%	0%	14%	**100%**
Female (23)	13%	0%	0%	22%	35%	17%	13%	**100%**
TOTAL (30)	**10%**	**3%**	**0%**	**23%**	**37%**	**13%**	**13%**	**100%**

1 – $0-$15,000 2 – $15,001-$25,000 3 – $25,001-$35,000 4 – $35,001-$50,000
5 – $50,001-$100,000 6 – $100,000 + 7 – Don't Know

Table 4.5: Table presenting the household income characteristics of the respondents in each of the three neighbourhoods participating in the questionnaire process

4.6 Conclusion

This chapter has introduced the nine neighbourhoods selected for this research in order to provide a basis for understanding how quality of resources and neighbourhood perception varies between the neighbourhoods. It has illustrated the location of resources that may influence obesity within each of the neighbourhoods as well as outlining the characteristics of questionnaire participants. The results outlined in the following two chapters can be considered in light of the information provided in this chapter.

Chapter Five
Investigating the Quality of the Built Environment

5.1 Introduction

The purpose of this chapter is to present the results relating to research objective one, the focus of which was to investigate how features of the built environment and their quality vary by area deprivation. Firstly, this chapter will outline the relationships between neighbourhood deprivation, green space and food resources identified from the previous chapter examining the location and variety of resources. The results from the systematic site survey tool developed for this research are then presented as well as a comparison of neighborhood quality between the three deprivation quintiles. It will also present the results of the three measures used to test the objectivity of the site survey tool. Finally, the influence of the NIMBY phenomenon in some of the neighbourhoods is outlined as this can affect the quality and utilisation of the neighbourhood environment.

5.2 Variety and Availability of Resources

Table 5.1 presents the results of a chi square test examining the relationship between deprivation, and a count of parks, healthy and unhealthy food resources. This table has been modified from Table 4.2 to amalgamate all neighbourhoods into their low, medium and high deprivation categories. Food resources have also been condensed into an unhealthy (petrol stations/fast food/convenience stores/bakeries) or healthy (supermarkets,

restaurant/cafes, fruiterers/butchers/fishmongers) category. The table shows that there is a significant relationship between these variables with the availability of resources being influenced by deprivation. This means that there is an unequal distribution of resources within these deprivation categories which can influence consumption and physical activity patterns of individual residing within these neighbourhoods.

Deprivation	Parks	Healthy Food	Unhealthy Food	Total
Low	15	18	13	46
Medium	23	78	47	148
High	18	8	25	51
Chi Square Value: 25.15**				

**** Significant at 0.01 level**

Table 5.1: Table presenting the results of a chi square test examining the relationship between deprivation and the count of resources within a neighbourhood

A chi square table of the relationship between deprivation and the count of parks or sports facilities showed no significant relationship. Alternatively, Table 5.2 presents the relationship between deprivation and healthy and unhealthy food resources. The table shows that there is a significant relationship between the count of food resources and deprivation. This relationship is not linear, however it shows that medium deprivation and high deprivation neighbourhoods have greater access to a variety of food resources than low deprivation neighbourhoods.

Deprivation	Healthy Food	Unhealthy Food	Total
Low	18	13	31
Medium	47	25	72
High	8	25	33
Chi Square Value: 15.5**			

**** Significant at 0.01 level**

Table 5.2: Table presenting the results of a chi square test examining the relationship between deprivation and the count of healthy and unhealthy food resources within a neighbourhood

The systematic site survey tool used in this study attempts to quantify the quality of the built environment features influencing obesity, the results of which are presented in the following section.

5.3 Results of the Site Survey Tool

The weighted results of the site survey tool are shown in Table 5.3 and Figure 5.1. Table 5.3 categorises the scores each neighbourhood received in the seven categories examined. The table shows each of the categories of the built environment assessed by the site survey tool and the weighted score each neighbourhood received for this category. These weighted scores were added together for a final total out of 24 where the higher the total, the higher the quality of the neighbourhood environment and the more likely it is to provide access to resources which can reduce the likelihood of obesity. Figure 5.1 is a graph of the quality of each of the neighbourhoods in percentage form, with 100% representing the highest quality neighbourhood and 0% representing the lowest.

The neighbourhood of St Albans has the highest quality built environment features with an overall score of 17.3 out of 24 (72%). Despite having some of the smaller area parks, the overall quality of green space within the neighbourhood is higher than those in other neighbourhoods. Green space areas within this neighbourhood not only provide safe and interesting places to relax, but also exceed expectations. For example, Packe Street Park in St Albans provides a community garden; visitors are permitted to pick flowers, fruit and herbs from the gardens providing they leave it in a respectable state. The neighbourhood also holds regular working bees to keep the park in good condition. Another example can be seen in Moa Park in St Albans where the local residents have created a community

compost facility (Figure 5.2). These are examples of where the local residents have made a considerable effort to look after their local resources and ensure they are available for the use of the whole community.

While the St Albans neighbourhood did have the overall highest quality of green space in the individual neighbourhoods, a special mention needs to be given to Woodham Park in the high deprivation Avonside neighbourhood as this green space area was of very high quality with a number of unique features. This park was exceptionally landscaped, provided two playgrounds for children of various ages, large areas for impromptu sports games and a landscaped rotunda (Figure 5.3). It also included a bird aviary next to one of the playgrounds; a feature not seen in any other park regardless of deprivation (Figure 5.4). A park such as this can be used for a variety of activities and as a result can increase an individual's use of the area, encourage physical activity and influence their obesity levels.

	Low Deprivation		Medium Deprivation				High Deprivation		
Category and Weighting	Avon-Heathcote	Aorangi	Edgeware	Barrington North	Islington	St Albans	Opawa	Avonside	Aranui
Urban Sprawl (3)	1.13	0.75	1.13	0.75	0	**2.25**	0.75	0.75	0.75
Road Connectivity (2)	2	2	2	2	2	2	2	2	2
Walkability (3)	0.5	2.25	2	2	1.25	1.5	2	**2.5**	2
Mixed Landuse (2)	1.33	1.67	1.67	1.67	1.67	**2**	**2**	1.67	1.67
Food Environment (5)	2.78	**3.33**	2.22	**3.33**	2.78	**3.33**	**3.33**	**3.33**	2.78
Green Space/ Playgrounds (5)	2.78	3.41	3.25	3.63	3.33	**4.20**	3.5	3.63	3.55
Crime and Safety (4)	1.67	2.33	2.33	**2.67**	1.33	2	2	2.33	2
Total	12.19/24	15.74/24	14.6/24	16.05/24	12.36/24	17.28/24	15.58/24	16.21/24	14.75/24
Total Percentage	51%	66%	61%	67%	52%	72%	65%	68%	61%

Table 5.3: Results the systematic site survey tool examining quality of built environment features within the neighbourhoods. The bold numbers signifies which neighbourhood scored highest in that category. The bracketed numbers next to the categories are the weightings used to allow comparison between the categories.

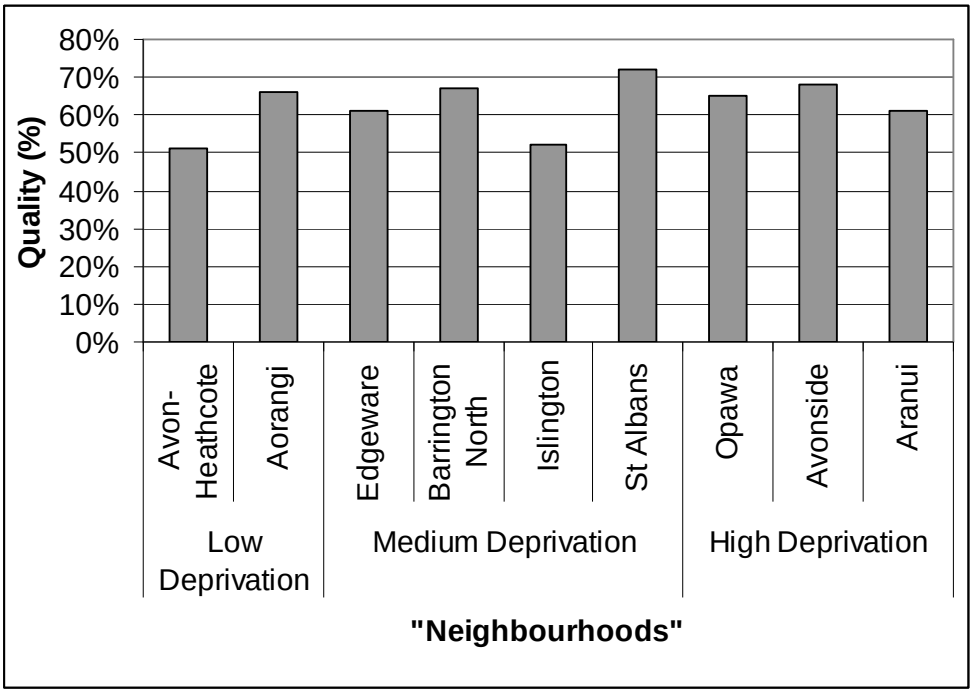

Figure 5.1: Graph of the results of the neighbourhood site survey tool indicating quality of each neighbourhood environment

Figure 5.2: Community composting bins and garden in Moa Park, St Albans

Figure 5.3: Landscaping and rotunda area in Woodham Park, Avonside

Figure 5.4: The bird aviary next to one of the playgrounds in Woodham Park, Avonside

The neighbourhood with the lowest quality resources was Avon Heathcote with a score of only 12.2 out of 24 (51%). It was the neighbourhood with the least walkability, having no shade provided for walking, no protection for pedestrians from road traffic and very few destinations that residents were able to walk to. The neighbourhood also scored the lowest in green space. This was due to the quality of the local playground structures within the parks. Despite being a deprivation one neighbourhood, these structures were mostly made of metal, relatively simple in structure and aimed at only one age group of children which decreased the safety of children using the park facilities.

The most walkable neighbourhood was Avonside. In this neighbourhood the pavements were well maintained, shade was provided for walking and pedestrians were protected from local traffic by green strips separating the pavement from the road. Edgeware had the lowest quality food environment largely due to its lack of a supermarket and specialty shops and the presence of a large number of takeaway outlets and convenience stores offering unhealthy alternatives. Finally, the neighbourhood of Barrington North was the safest according to the site survey tool. Most streets had a neighbourhood watch group set up, and many of the green space areas were overlooked by properties increasing the safety of those utilising the area. Some graffiti was present within the neighbourhood although the majority had been painted over, indicating that residents took pride in their neighbourhood and were not going to tolerate vandals in the area. This was opposed to the Islington neighbourhood which, while some streets had a neighbourhood watch group set up, vandalism and graffiti were widespread and the presence of untidy abandoned lots dotted amongst residential homes decreased the overall safety of the neighbourhood.

The above results have illustrated how quality of the built environment varies between neighbourhoods. As the first aim of this thesis was also to examine how the quality of the environment varies between overall area deprivations, Figure 5.5 presents the averaged percentage score of the neighbourhoods in each deprivation category. While the St Albans and Avon Heathcote neighbourhoods were the best and worst of the individual neighbourhoods, it shows that neighbourhoods in high deprivation areas have higher quality resources available than neighbourhoods in medium or low deprivation areas overall, the opposite relationship to what international literature suggests. This means that these neighbourhoods have resources that may be less likely to promote obesity than neighbourhoods with lower quality resources.

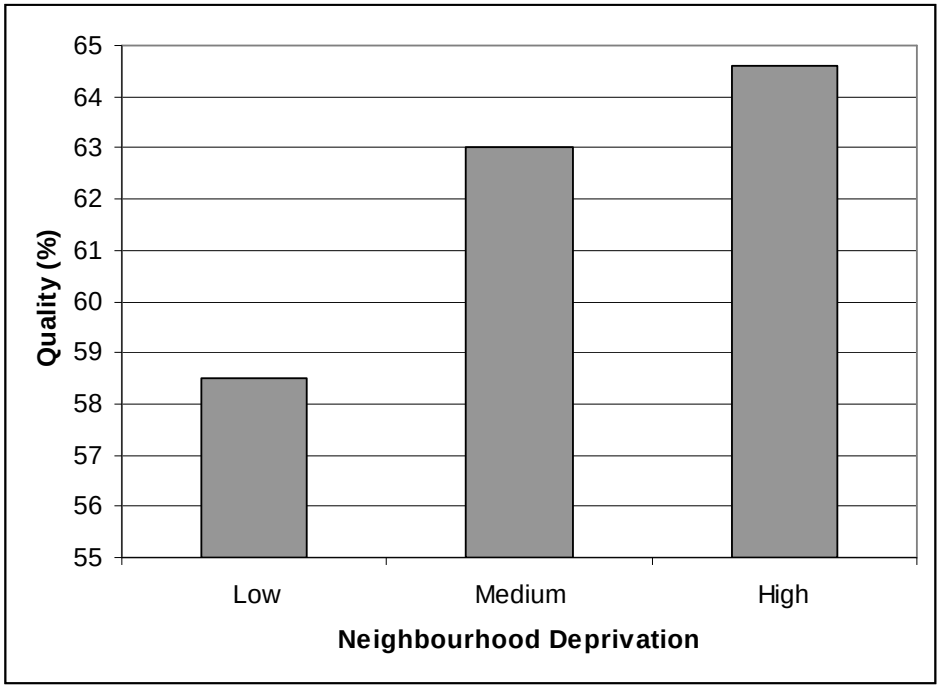

Figure 5.5: Graph of average of percentage scores for each neighbourhood deprivation quintile category showing that the quality of built environment features in a neighbourhood increases as deprivation increases

5.4 Results of the Objective Measures

Four other measures were used in this thesis in an attempt to provide objective results that validate the results of the systematic site survey. These measures tested the connectivity of the neighbourhood bus system, the accessibility of green space, the walkability of area and the safety within the neighbourhood. The results of these four measures intend to lend weight to the results presented in the previous section as they use networks and features firmly established within the neighbourhood area rather than a subjective decision about the neighbourhood. Should the objective measures show similar results and relationships to those found by the site survey tool, we can assume that the site survey tool has correctly identified the relationships in these neighbourhoods.

5.4.1 Neighbourhood Connectivity

Table 5.4 outlines the average number of bus stops and length of bus routes within each neighbourhood with the greater the number of bus stops and length of bus route providing more connectivity to adjacent neighbourhoods. The St Albans neighbourhood is the most connected in both numbers of bus stops and total bus route length. This is a result of its close proximity to the CBD and the local bus exchange. As a result, local buses travel from the outer suburbs of Christchurch, through the neighbourhood to the bus exchange. The least connected neighbourhood is Islington with only 15 bus stops throughout the entire neighbourhood. This is largely due to its changing focus from urban to rural land use. However, neighbourhood deprivation averages show that as the overall deprivation of the neighbourhood increases, the connectivity to the city centre and adjacent neighbourhoods also increases.

Consequently, high deprivation neighbourhoods in this study were slightly more connected with an average of 34.3 bus stops and 5383 metres of total bus route length.

Neighbourhood	Neighbourhood Deprivation	Number of Bus Stops	Average Number of Bus Stops per neighbourhood deprivation	Total Bus Route Length (m)	Average Bus Route Length per Deprivation (m)
Avon Heathcote	Low	22	28.5	4348	4431
Aorangi		35		4514	
Edgeware	Medium	35	34.0	4980	5371
Barrington North		34		3922	
Islington		15		3838	
St Albans		52		8744	
Opawa	High	44	34.3	5595	5383
Avonside		39		6869	
Aranui		20		3685	

Table 5.4: Table of the total number of bus stops and bus route length within each neighbourhood and the overall percentage in each deprivation category

5.4.2 Accessibility of Green Space

Table 5.5 displays the results of examining the accessibility of green space within each neighbourhood. As the purpose of this was to examine how much access residents in the neighbourhood had to green space rather than the quality of the green space, the results differed to that of the site survey tool. The neighbourhood with the highest accessible green space is Aranui with 42.2% of the total neighbourhood area available for physical activity. Only 2.06% of the total neighbourhood area was dedicated to areas of accessible green space in St Albans despite this neighbourhood having the highest quality green space. The high deprivation neighbourhoods had the greatest

access to green space and as a result are more likely to increase the potential that individuals will engage in physical activity.

Neighbour-hood	Neighbour-hood Deprivation	Total Accessible Green Space (km^2) (TAGS)	Neighbour-hood Area (km^2) (NA)	Total Green Space in Neighbourhood (%) (TAGS/NA)	Average amount of Green Space by neighbourhood deprivation (%)
Avon Heathcote	Low	0.42	2.12	19.69	14.15
Aorangi		0.18	2.08	8.62	
Edgeware	Medium	0.16	2.09	7.85	8.08
Barrington North		0.19	2.11	9.09	
Islington		0.30	2.24	13.30	
St Albans		0.04	2.02	2.06	
Opawa	High	0.40	2.19	18.22	26.62
Avonside		0.43	2.18	19.65	
Aranui		1.21	2.89	42.15	

Table 5.5: Table of the total accessible green space within each neighbourhood, the percentage of the neighbourhood this covers and the overall percentage of green space in each deprivation category

5.4.3 Walkability of the Neighbourhood

Walkability of the neighbourhood is an important influence on obesity levels through its ability to encourage residents to increase walking for both leisure and transport means. A higher number of footpaths available for residents to walk mean they are able to reach more destinations around their neighbourhood. Table 5.6 outlines the total length of footpath available in each neighbourhood and the average length of footpath by deprivation category.

The most walkable neighbourhood was Opawa with 56.39 kilometres of footpath for walking. The least walkable neighbourhood was Avon-Heathcote. As the majority of housing in this neighbourhood is located on a hillside with winding narrow roads, the provision of footpaths is not always possible. This reduces the safety of residents walking in the neighbourhood as they are required to walk on the road itself increasing the likelihood that residents will use alternative means of transport.

As the level of deprivation of a neighbourhood increases, the average length of walkable footpath also increases. As a result, high deprivation neighbourhoods have between 6.6 kilometres and 11.9 kilometres more walkable footpaths than low or medium deprivation neighbourhoods respectively.

Neighbourhood	Neighbourhood Deprivation	Total Footpath Length (km)	Average Footpath Length per Neighbourhood Deprivation (km)
Avon-Heathcote	1.5 (Low)	47.99	41.45
Aorangi		34.92	
Edgeware	3 (Medium)	53.67	46.77
Barrington North		37.14	
Islington		36.24	
St Albans		60.03	
Opawa	4.3 (High)	56.39	53.37
Avonside		51.91	
Aranui		51.81	

Table 5.6: Table of the Walkability of the neighbourhood determined by the total length of footpath in each neighbourhood and the overall length in each deprivation category

Table 5.7 presents the number of roads within each neighbourhood and what percentage of each road category is present. The neighbourhood with the highest volumes of traffic is St Albans with 26.38% of all roads in this neighbourhood being either a minor or major arterial road. High traffic volumes decrease the safety of individuals walking in

the neighbourhood through their lack of safe areas to cross streets. They also increase both the noise and air pollution of the area which can have significant health effects on those frequently walking through this neighbourhood. The lowest volumes of traffic are in Aranui which has the highest number of local roads and the third highest number of private roads. This neighbourhood may be more appealing to walking individuals as lower levels of traffic make crossing roads safer and increases the aesthetics of the area through lower noise and air pollution levels.

Neighbourhood	Neighbourhood Deprivation	Total Number of Roads	% Local Road	% Private Road	% Collector Road	% Arterial Road
Avon-Heathcote	1.5 (Low)	694	52.74	7.64	21.18	17.92
Aorangi		1171	57.98	2.73	15.2	18.96
Edgeware	3 (Medium)	1472	67.39	0.82	8.22	22.69
Barrington North		1565	67.73	4.92	9.52	13.29
Islington		770	70.91	2.99	14.68	7.40
St Albans		1770	49.94	2.37	18.31	26.38
Opawa	4.3 (High)	1346	69.09	2.30	8.54	17.61
Avonside		1362	59.77	4.04	10.72	22.10
Aranui		1310	73.66	3.05	1.22	19.85

Table 5.7: Table of the percentage of each type of road within a neighbourhood as an indicator of walkability and resident safety

5.5 Conclusion

This chapter has presented the results of the first aim of this thesis: to investigate how features of the built environment and their quality vary by area deprivation. It has

presented the results of the site survey tool examining the quality of available neighbourhood resources and the objective measures validating the site survey tool.

This chapter has three key findings. The St Albans neighbourhood had the highest quality resources and was the most likely to reduce obesity in an individual neighbourhood. The most important finding was that quality of resources increased as neighbourhood deprivation increased. Additionally, results from the objective measures similarly found that neighbourhood walkability, connectivity and accessible green space all increased as neighbourhoods became more deprived.

Traditionally, research examining the variation of resource quality by neighbourhood deprivation has found that resource quality decreases as neighbourhoods become more deprived. Results from this thesis suggest the opposite relationship. As a result, neighbourhoods based on the urban design principles of high deprivation neighbourhoods may be less likely to promote obesity.

As the utilisation of resources within a neighbourhood depend largely on residents' perceptions of the resources, Chapter Six will present the results pertaining to the Likert Scale questionnaire to examine how residents perceive their own neighbourhoods and whether there is a mismatch between the resources provided and residents' perception of them.

Chapter Six
Neighbourhood Perceptions as an Influence of Resource Utilisation

6.1 Introduction

The intention of this chapter is to present the results relating to research objective two, the aim of which was to understand how the perceptions of individuals living in a neighbourhood can influence dietary and physical activity behaviour. The questions are broken into three categories. These categories are the food environment, green space and physical activity, and neighbourhood safety. Perceptions of whether a resource is available or not within a neighbourhood can influence dietary and physical activity choices and ultimately influence the prevalence of obesity within a neighbourhood. Finally, the differences between the perception of the neighbourhood residents and the objective results outlined in the previous chapter are examined as this may influence the likelihood of individuals utilising certain resources.

6.2 Questionnaire Results

This section presents the results from the questionnaire distributed in the Aorangi, Islington and Opawa neighbourhoods. It is broken down into three sub-sections in an attempt to understand how residents' perceptions of their surrounding neighbourhood can influence the likelihood of an obesogenic environment. The inclusion of a chi square value for each question indicates whether there is a significant relationship between deprivation participants' perception of their neighbourhood.

6.2.1 Food Resources

Table 6.1 presents the participants' perceptions of the food resources in each of the three neighbourhoods. While most of the participants' responses were patterned by deprivation, not all of these were significant relationships. Participants were given a set of seven questions about neighbourhood food resources and asked how strongly they agreed or disagreed with the statement. They were also asked how satisfied they were living in the neighbourhood as individuals who are less satisfied with the surrounding neighbourhood are more likely to have a negative perception of their neighbourhood (Collins et al. 2009). Satisfaction with the neighbourhood increased as deprivation increased with 80% of the Opawa residents being very satisfied with their surrounding neighbourhood compared to only 37% in the low deprivation Aorangi neighbourhood.

The majority of residents in all three neighbourhoods preferred to shop at a supermarket rather than at a local dairy or convenience store, however, the number of individuals shopping at local dairies slightly increased as deprivation increased. While 33% of the residents in the Aorangi neighbourhood agreed that there were many healthy options for eating out within their neighbourhood, residents of the Islington and Opawa neighbourhoods were unsure with 46% and 40% stating that they neither agreed nor disagreed with this statement respectively.

More than 50% of the residents in each neighbourhood agreed or strongly agreed that they had access to a specialty store such as a fruiterer or butchery. When asked whether there were many fast food restaurants in their neighbourhood, 77% of Aorangi residents and 87% of Islington residents agreed or strongly agreed that there were many. Conversely, 60% of Opawa residents did not agree with this statement. This may mean

that residents in this neighbourhood believe that there is both a lack of healthy and unhealthy food resources within their neighbourhood area which may affect their food choices.

The most significant relationship regarding food resources and deprivation occurs when participants were asked whether there were many fast food restaurants available within their neighbourhood. Residents' perceptions of the availability of fast food outlets within their neighbourhood is patterned by deprivation with the high deprivation Opawa neighbourhood being the least likely to agree that there are many fast food restaurants available.

The final two questions relate to the residents' consumption of healthy food resources. International literature has suggested that in some areas such as the United States, access to affordable healthy food resources decreases as deprivation increases (Guy et al. 2004, Inglis et al. 2008). This relationship is not apparent in these neighbourhoods as Islington residents are the most likely to agree that limited neighbourhood resources makes it hard to eat healthy, and Opawa residents are the most likely to disagree with this statement. When asked whether their household could not afford to buy healthy and nutritious food, 16% of Aorangi residents and 10% of Islington and Opawa residents agreed with this statement. While many of the Opawa residents disagreed with the above statement, many of them made the comment that they would not use the local organic butcher because they thought it was too expensive.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Chi Square Value
I am satisfied with the area I live in						
Aorangi	37%	**50%**	10%	3%	0%	3.96
Islington	**50%**	33%	7%	10%	0%	
Opawa	**80%**	13%	7%	0%	0%	
I often shop at local grocery stores/dairies for my food rather than going to a supermarket						
Aorangi	3%	13%	10%	33%	**40%**	0.15
Islington	0%	20%	10%	30%	**40%**	
Opawa	7%	13%	10%	**43%**	27%	
Shops are within easy walking distance of my home						
Aorangi	37%	**53%**	3%	2%	0%	2.49
Islington	**48%**	40%	6%	6%	0%	
Opawa	**53%**	40%	7%	0%	0%	
There are lots of healthy options for eating out in my local neighbourhood						
Aorangi	20%	**33%**	23%	20%	3%	5.65
Islington	3%	28%	**46%**	13%	10%	
Opawa	13%	17%	**40%**	23%	7%	
I have access to a specialty store (fruit and vegetable/butchers etc) in my neighbourhood						
Aorangi	30%	**50%**	13%	7%	0%	0.67
Islington	27%	**57%**	10%	3%	3%	
Opawa	**53%**	33%	7%	7%	0%	
There are many fast food restaurants in my neighbourhood						
Aorangi	20%	**57%**	10%	10%	3%	40.97**
Islington	20%	**67%**	13%	0%	0%	
Opawa	3%	13%	23%	23%	**37%**	
It is difficult to eat healthy because healthy food options are often limited						
Aorangi	10%	13%	27%	**40%**	10%	5.32
Islington	3%	**27%**	23%	**27%**	20%	
Opawa	3%	10%	13%	30%	**43%**	
Sometimes my household can not afford to buy healthy and nutritious food						
Aorangi	3%	13%	7%	**40%**	37%	2.04
Islington	7%	3%	17%	**50%**	23%	
Opawa	3%	7%	13%	23%	**53%**	

**** Significant at 0.01 level**

Table 6.1: Residents' perceptions of the local food resources within their neighbourhood

6.2.2 Green Space/Physical Activity

The perception by residents that there are many areas to engage in physical activity is an important influence on obesity. Table 6.2 illustrates the perceptions of residents within the three neighbourhoods when asked about areas of green space and physical activity within their neighbourhood.

The perception that the neighbourhood offers many opportunities to be active is important as those who perceive that there are areas available for them are more likely to use these facilities (Saelens et al. 2003). The perception that the neighbourhood has many opportunities to be active showed a significant relationship with deprivation where perceptions of activity opportunities increased as deprivation increased. 90% of Opawa residents either agreed or strongly agreed with this statement with only 56.5% of Islington participants and 60% of Aorangi participants perceiving that their neighbourhood offers many physical activity opportunities. This may mean that Opawa residents are more likely to engage in physical activity within their own neighbourhood as they believe there are plenty of areas available to them.

In turn, higher levels of physical activity may mean this neighbourhood is less likely to promote obesity. When asked whether there were parks or areas of physical activity in the neighbourhood that residents could easily walk to, all three neighbourhoods strongly agreed with this statement (50% Aorangi, 43.5% Islington, 77% Opawa). Chi square tests revealed that this was a significant relationship with the perception that there are areas to engage in physical activity being influenced by deprivation. Many of the participants then agreed that they regularly visit these park areas for physical activity

and went on to further state that having a park in their neighbourhood is important to them.

Having a park or area of physical activity in the neighbourhood was most important to Opawa residents (94%), followed by the Aorangi neighbourhood (90%), and finally Islington (80%). A park may be less important to residents in the Islington neighbourhood as they were more likely to prefer to get their physical activity requirements through the use of a gym facility (26.5% compared to 7% in Aorangi and 13% in Opawa).

Finally, the perception that there are bicycle and pedestrian trails within a neighbourhood increases the variety of forms of physical activity residents are able to engage in. When asked whether there were bicycle and pedestrian trails nearby, Opawa residents were most likely to agree with this statement with 90% of the participants either agreeing or strongly agreeing indicating a significant relationship with deprivation. This perception is in part a result of the presence of the Avon River which has green waterway reserves on both banks and is an obvious and often utilised area of residents to engage in physical activity.

Residents of the Islington neighbourhood were least likely to agree that there were bicycle and pedestrian trails nearby. The perception that there were fewer areas in Islington for physical activity may be in part due to the changing from urban to rural land use, where lower levels of population and higher industrial land use changes the purpose of the neighbourhood. Overall, residents in the Opawa neighbourhood were

more likely to perceive that there were areas within the neighbourhood to engage in physical activity.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Chi Square Value
My neighbourhood offers many opportunities to be active						
Aorangi	27%	**33%**	27%	10%	3%	9.46*
Islington	14%	**43%**	30%	14%	0%	
Opawa	**63%**	27%	7%	3%		
There are playgrounds, parks or beaches close by that I can walk to						
Aorangi	**50%**	47%	0%	3%	0%	10.31*
Islington	**43%**	**43%**	14%	0%	0%	
Opawa	**77%**	23%	0%	0%	0%	
I regularly visit parks or playgrounds for physical activity						
Aorangi	23%	**53%**	10%	7%	7%	4.08
Islington	17%	**36%**	23%	17%	7%	
Opawa	**43%**	23%	20%	7%	7%	
Having a park or areas of physical activity in my neighbourhood is important to me						
Aorangi	**57%**	33%	10%	0%	0%	3.73
Islington	**43%**	37%	17%	3%	0%	
Opawa	**67%**	27%	7%	0%	0%	
I prefer to get my physical activity indoors (eg gym facilities etc)						
Aorangi	0%	7%	**33%**	**33%**	27%	9.54*
Islington	16%	11%	**37%**	20%	16%	
Opawa	3%	10%	17%	**43%**	27%	
There are bicycle or pedestrian trails in or near my neighbourhood that are easy to get to						
Aorangi	27%	**53%**	10%	10%	0%	23.13**
Islington	7%	30%	**43%**	17%	3%	
Opawa	**57%**	33%	7%	3%	0%	

*** Significant at 0.05 level ** Significant at 0.01 level**

Table 6.2: Residents perceptions of the local physical activity resources within their neighbourhood

6.2.3 Neighbourhood Safety

How safe an individual feels within their own neighbourhood is an important influence on their level of physical activity as feeling safe when out alone is more likely to increase the extent to which people utilise the resources within their neighbourhood.

The participants in each neighbourhood were asked a series of seven questions regarding their safety within the neighbourhood (Table 6.3). While there were relationships identified between deprivation and crime and safety, none of these were significant.One of the most common responses when answering this questionnaire was that participants would feel safe walking alone during the day, but would never walk at night. This pattern was obvious within all three neighbourhoods with up to 70% of participants stating that the neighbourhood was safe for walking during the day. Conversely, 33% in the Aorangi neighbourhood and 40% in the Islington neighbourhood perceived the neighbourhood to be unsafe for walking during the night. Only 13% of Opawa residents believed it would be unsafe to walk at night. The perception that the neighbourhood streets were well lit may influence this as 60% (Aorangi), 77% (Islington) and 80% (Opawa) of residents perceived there was adequate lighting.

Residents did not perceive that the level of neighbourhood traffic would impinge on one's safety when exercising in the neighbourhood, despite some of the areas being adjacent to high traffic road networks. How comfortable parents feel letting children play out on the street, or unsupervised in the park is a good indicator of how safe the neighbourhood is. In Aorangi, residents could not agree whether it was safe to let children play out on the street, and lent towards disagreeing that it was safe to let children play unsupervised. This is compared to Islington where safety is not obviously a big concern as 40% of the participants in this neighbourhood believed that it was not dangerous to let children play out in the front yard or on the street, and 30% agreed that letting children play in the playground unsupervised was also safe. The majority of Opawa residents could neither agree nor disagree on whether letting children out to play

was unsafe or not although more residents tended to disagree with both statements than agree. Finally, participants were asked whether fear about their safety is a reason they don't exercise within the neighbourhood. The majority of participants within all three neighbourhoods disagreed with this statement. Overall, the neighbourhoods are perceived as safe areas for individuals to exercise and interact within.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Chi Square Value
The neighbourhood is safe for walking during the day						
Aorangi	**53%**	37%	10%	0%	0%	3.66
Islington	**54%**	43%	3%	0%	0%	
Opawa	**70%**	30%	0%	0%	0%	
The neighbourhood is safe for walking during the night						
Aorangi	7%	30%	27%	**33%**	3%	8.79
Islington	20%	10%	30%	**40%**	0%	
Opawa	13%	17%	**57%**	13%	0%	
Neighbourhood traffic in the area makes physical activity unsafe						
Aorangi	0%	33%	20%	**40%**	7%	5.24
Islington	3%	13%	30%	**47%**	7%	
Opawa	0%	13%	20%	**47%**	20%	
My neighbourhood streets are well lit						
Aorangi	13%	**47%**	27%	10%	3%	7.15
Islington	20%	**57%**	7%	13%	3%	
Opawa	27%	**53%**	17%	3%	0%	
Letting children play outside in my neighbourhood is dangerous						
Aorangi	0%	23%	**33%**	27%	7%	2.88
Islington	7%	23%	23%	**40%**	7%	
Opawa	7%	10%	**40%**	30%	13%	
Letting children play in the playground unsupervised is safe						
Aorangi	9%	13%	**33%**	**33%**	13%	6.04
Islington	10%	**30%**	17%	17%%	26%	
Opawa	7%	13%	**40%**	27%	13%	
I don't exercise in my neighbourhood because I am worried about my safety						
Aorangi	0%	0%	7%	**53%**	40%	5.18
Islington	0%	0%	23%	**53%**	23%	
Opawa	0%	0%	7%	33%	**60%**	

*** Significant at 0.05 level ** Significant at 0.01 level**

Table 6.3: Residents perceptions of the safety of their neighbourhood

6.2 Perceived versus Actual Resources in a Neighbourhood

To understand whether residents have an accurate perception of their environment, participant's responses can be compared to the objective results outlined in the previous chapter regarding food resources, physical activity areas and crime and safety.

6.3.1 Food Resources

The perceptions of residents in the three different neighbourhoods highlight a number of things. The first of these is that in certain neighbourhoods, the size of the neighbourhood is perceived to be much larger than both academically defined, and the definition of neighbourhood used in this these (800 metre buffered area). An example of this can be seen in the medium deprivation Islington neighbourhood. While the Aorangi and Opawa neighbourhoods did have access to at least one fruiterer and butchery, residents in the Islington neighbourhood believed they had access to both. They did in fact have access to a butcher within the initial 800 metre neighbourhood buffer however there was no access to a fruiterer indicating that their perception of their neighbourhood is much larger than other common neighbourhood definitions.

When asked whether there were many food options near participants homes, low deprivation Aorangi residents were the most likely to agree with this statement. Comparing this to the count of available healthy resources outlined in Chapter Four (Table 4.2) shows that Aorangi has the greatest number of healthy resources available of all three neighbourhoods. While the access the participants have to healthy food choices such as supermarkets and butcheries is disproportionate, this is not reflected in participant's ability to afford or purchase them. In fact, the high deprivation Opawa neighbourhood is the least likely to agree that this is the case. The comparison between

objective and perceived food resources shows that while there is a high level of inequality between the variety and number of resources provided in the neighbourhoods, participants are aware of what is available in their neighbourhood environment and change the size of their neighbourhood area to suit their needs.

6.3.2 Green Space/Physical Activity

Perceived versus actual amount of green space can be measured more accurately. The objective measure examining the variation in amount of accessible green space outlined in section 5.3.2 showed that the percentage of accessible green space within the neighbourhoods is unequal, increasing as deprivation increases (8.6%, 13.3% and 18.2% in low, medium and high deprivation neighbourhoods respectively). This was reflected in the perceptions of neighbourhood residents with participants in the high deprivation Opawa neighbourhood being the most likely to perceive that their neighbourhood has a number of parks, playgrounds and other green space areas to engage in physical activity. The combination of increased access and the perception that there is a wide variety of green space available within the Opawa neighbourhood can decrease the likelihood that this could be an obesogenic environment.

6.2.3 Neighbourhood Safety

The safety of residents while out in the neighbourhood is an important influence on physical activity. Part of the site survey tool was to examine the presence of incivilities (eg graffiti, vandalism, abandoned lots) in the neighbourhoods as a proxy for neighbourhood crime as incivilities can indicate greater crime levels. The Aorangi neighbourhood had the highest crime and safety score (56%) of all three neighbourhoods examined and the Islington neighbourhood the lowest (33%). This

means that the Aorangi neighbourhood was the safest overall in terms of the criteria used in the site survey tool. Of all three neighbourhoods, residents in the high deprivation Opawa neighbourhood were the most likely to perceive that their neighbourhood was safe during both the day and night. This may suggest that the presence of incivilities in a neighbourhood does not have a large influence on residents' perception of their safety.

Combined with this, an examination of the dominant road types within the neighbourhood can be an indicator of safety from traffic while out exercising. The Aorangi neighbourhood had the highest percentage of arterial roads within the neighbourhood indicating high volumes of neighbourhood traffic (19%, 7.4% and 17.6% in low, medium and high deprivation respectively). The residents in the Aorangi neighbourhood were the most likely to perceive that neighbourhood traffic did make physical activity unsafe however the majority of participants believed that traffic was not a deterrent of physical activity in the neighbourhood.

6.3.4 Time and Distance to Resources

Finally, participants were asked how long they thought it would take to walk to the nearest food resource in the neighbourhood. The perception that a resource is an easily walkable distance from an individual's home increases the chance that they will walk to it when needed and, as a result, may decrease the likelihood of obesity within that neighbourhood. Table 6.4 displays the responses of participants as well as the actual distances and time it would take to walk to the resource.

While participants within the Aorangi and Islington neighbourhoods correctly perceived that a local convenience store or dairy was located less than ten minutes walk from their home, the majority of residents in the Opawa neighbourhood overestimated the time it would take to reach such an amenity. Of the three neighbourhoods, the shortest time to reach one of these facilities was in the Opawa neighbourhood where it would take on average 2.5 minutes to reach the closest dairy compared to 10.28 minutes in Islington and 9.36 minutes in Aorangi.

The neighbourhood with the best actual walking access to a supermarket was Aorangi with only a 12 minute walk. This was compared to the Opawa neighbourhood, where residents would have to walk almost 30 minutes to reach a local supermarket outside their neighbourhood area. There was however a mismatch between the time participants perceived it would take to reach a supermarket and the actual time as the majority of Opawa participants believed a supermarket was within a ten to twenty minute walk of their home. This highlights the inequality in the location of supermarkets with residents in the low deprivation neighbourhood having greater access to these supermarkets than higher deprivation neighbourhoods. This can potentially influence the food choices of residents and may promote healthier choices in the lower deprivation neighbourhood.

The time it would take to reach a fast food restaurant was also patterned by deprivation with a greater walking time in neighbourhoods of higher deprivation. The closest available fast food restaurant was in the Aorangi neighbourhood at 11.4 minutes, and was correctly identified by Aorangi residents as between ten and twenty minutes walk from their home. Residents of the Islington neighbourhood believed that a fast food

restaurant was available within a ten minute walk of their home; however the actual time it would take to walk to one of these facilities was more than 18 minutes.

Conversely, the time it would take to reach a local takeaway, such as a fish and chip shop decreased as deprivation increased, both in actual, and perceived time to reach the amenity. While local takeaways are more readily available, the fact that non- fast food restaurants and supermarkets within all three neighbourhoods are closer to individual's homes than fast food restaurants may go a small way towards encouraging healthier consumption patterns and reducing the obesity of the neighbourhood.

	<5 mins	5-10mins	10-20mins	30+mins	Actual Distance and Time	
How long would it take to get from your home to the nearest facility If you walked					Distance (metres)	Time (minutes)
Small grocery store/convenience store						
Aorangi	**50%**	**50%**	0%	0%	780	9.36
Islington	**41%**	**41%**	18%	0%	857	10.28
Opawa	43%	**50%**	7%	0%	207	2.5
Supermarket						
Aorangi	3%	47%	**50%**	0%	1000	12
Islington	3%	**45%**	**45%**	7%	1559	18.70
Opawa	17%	30%	**50%**	3%	2441	29.3
Fast food restaurant (McDonalds etc)						
Aorangi	3%	37%	**53%**	7%	950	11.4
Islington	7%	**45%**	41%	7%	1575	18.9
Opawa	0%	3%	23%	**73%**	2368	28.42
Non-fast food restaurant (eat in dining)						
Aorangi	27%	**43%**	30%	0%	673	8.07
Islington	3%	**45%**	41%	11%	289	3.47
Opawa	10%	17%	**40%**	33%	909	10.09
Takeaway outlet (eg Fish and Chips)						
Aorangi	17%	**70%**	13%	0%	976	11.72
Islington	45%	**48%**	7%	0%	868	10.65
Opawa	**60%**	33%	7%	0%	6.98	8.37

Figure 6.4: Perceived walking times to the nearest local food resource versus actual walking times to reach resource

6.3 Conclusion

The perception of residents within a neighbourhood can have an important influence on utilisation of resources. This chapter has presented the results of the questionnaires examining neighbourhood perceptions in Aorangi, Islington and Opawa. It has shown that perception of the environment varies as a result of the resources available, characteristics of the overall deprivation and population composition within a neighbourhood. In summary, participants in the questionnaire process are generally satisfied with the neighbourhood they live in, and believe that they are safe environments that offer many food options and areas for physical activity with many amenities within easy walking distance. A discussion of the neighbourhoods most likely to influence obesity based on the objective and subjective results is available in the following chapter.

Chapter Seven
Discussion

7.1 Introduction

Understanding the influence of the environment is an important step in explaining variation in obesity prevalence. By understanding how different neighbourhood environments are more or less likely to promote obesity, planning and policy measures can be adopted that may reduce an individuals propensity to be obese. Considerable international research has been undertaken examining the relationship between deprivation and the built environment and how this influences obesity. However, few have considered how the quality of these built environment features varies by deprivation and how this can influence utilisation of these resources. Furthermore, the issue of obesogenic environments has received very little attention in New Zealand to date. This research addressed some of these deficiencies by examining the influence of deprivation on the quality of neighbourhood resources and the perceptions of neighbourhood residents in Christchurch.

This chapter is divided into five sections and discusses the key findings of this thesis in relation to the international and national literature. The first section examines the main themes associated with the access and abundance of resources in the neighbourhoods. The second section examines the major findings of the quality of built environment resources compared to the international literature. The third section analyses the perceptions of the neighbourhood residents in order to understand their influence on

resource utilisation. Finally the last two sections discuss the limitations of the study and the policy implications of this research.

7.2 Key Findings

Four key themes were identified regarding the role of deprivation on the built environment. First, there was a significant relationship between neighbourhood deprivation and the count of available resources. Second, the quality of neighbourhood resources increased as deprivation increased. Third, residents in the high deprivation neighbourhood had the most positive perception of their neighbourhood which would influence their utilisation of healthier resources. Finally, neighbourhoods of high deprivation were least likely to be obesogenic as these neighbourhoods had a higher quality of available resources and more positive resident perceptions.

7.3 Access and Variety of Resources within a Neighbourhood

The access that individuals have within a neighbourhood to certain resources that influence consumption and energy expenditure are an important determinant of obesity. Results from this study show that there is a significant relationship between neighbourhood deprivation and access to available resources.

7.3.1 Green Space and Physical Activity

A greater number of green space and sports facility areas within a neighbourhood can increase the access residents have to these areas in any given part of the neighbourhood. Research in the US, UK, Europe and Australia has shown that in residential environments with high levels of greenery the likelihood of using green space areas is two times as high, the likelihood of being physically active is three times as high, and

the likelihood of being obese up to 40% less (MacDougall et al. 1997, Ellaway et al. 2005, Giles-Corti et al. 2005, Nielson and Haansen 2007, Stafford et al. 2007, Mota et al. 2009).

Research in New Zealand has found that at a national level, the time and distance to a green space area is less in more deprived neighbourhoods (Pearce et al. 2007a, Pearce et al. 2007b). This contrasts many of the international studies which have found that access to areas of green space increase as neighbourhoods become less deprived (Estabrooks et al. 2003, Powell et al. 2004, Powell et al. 2006). Findings from this study are inconsistent with New Zealand research as the average number of green space areas and sports facilities within an 800 metre neighbourhood decreases as deprivation increases (9 in low deprivation, 8 in medium deprivation and 7 in high deprivation neighbourhoods). Based on these relationships, a low deprivation neighbourhood is more likely to promote higher levels of physical activity and lower levels of obesity as residents have greater access to these areas.

7.3.2 Food Resources

The relationship between access to food resources and obesity within a neighbourhood is slightly more complex than physical activity. Considerable research has been conducted examining the impact of neighbourhood access to shops and outlets selling healthy and unhealthy food and if this varies by deprivation. Research in the United States has promoted the existence of 'food deserts' where foods integral to a healthy diet are inaccessible to low income households in poor neighbourhoods (Winkler et al. 2006). The bulk of these studies have found that more deprived neighbourhoods often have a lower concentration of supermarkets (Morland et al. 2002), up to four times as

many grocery stores, (Moore and Diez-Roux 2006) and a higher fast food density than affluent, predominantly white neighbourhoods (Block et al. 2004).

While there is some support for the presence of food deserts outside of the United States (Cummins and Macintyre 1992, Ellaway and Macintyre 2000, Clarke et al. 2002, MacDonald et al. 2007) many studies, including those undertaken in New Zealand, have found that the opposite relationship is prevalent with access to resources such as supermarkets favouring more deprived neighbourhoods (Cummins and Macintyre 1999, Field et al. 2004, Winkler et al. 2006, Pearce et al. 2007b, Pearce et al. 2008a).

Results from this study are mixed. Using a dichotomy of unhealthy or healthy food resource shows that both low and medium deprivation neighbourhoods have healthier food resources than unhealthy. These neighbourhoods have greater access to supermarkets, restaurants/cafes, fruiterers, green grocers and butchers. Alternatively, high deprivation neighbourhoods have almost three times as many unhealthy food resources as healthy. This would suggest that food deserts may be a problem within these neighbourhoods as high deprivation neighbourhoods would have easier access to unhealthy food resources that promote obesity. However, as the overall number of fast food and takeaway outlets decrease as neighbourhoods become more deprived, the relationship may not be as clear cut.

7.4 Quality of resources

Many studies have examined the effects of deprivation on food resources (van Lenthe and Mackenbach 2002, Turrell et al. 2004), green space (Giles-Corti 2005, Ellaway et al. 2007) and other resources such as crime and incivilities (Ellaway et al. 2005). To date

however, few studies have examined how the quality of features of the built environment varies by neighbourhood. Of those examining the variation in quality of resources by deprivation, the features examined were of lower quality in deprived neighbourhoods with poor health outcomes (Lee et al. 2005, Coen and Ross 2006).

The results from the site survey tool developed for this thesis suggest the opposite relationship with overall quality of resources increasing as deprivation increases. Given that much of the research investigating access to community resources within New Zealand has shown that the most deprived neighbourhoods have the best access to resources, this result is perhaps not very surprising (Field et al. 2004, Pearce et al. 2007b, Pearce et al. 2008b). These neighbourhoods have access to a number of different built environment features of higher quality than other deprivation neighbourhoods. Quality in this sense is based on the idea that the higher the quality of a certain feature, the less likely it will promote obesity within a neighbourhood. For example, a high quality green space area within a deprived neighbourhood is likely to encourage greater physical activity through access to a safe, aesthetically pleasing environment that can be utilised by all ages, and that exceeds the simple requirements of a local neighbourhood park.

7.4.1 Why do more deprived neighbourhoods have better quality resources?

There are a number of explanations as to why the quality of built environment features may be better in high deprivation neighbourhoods. Past planning and zoning measures in New Zealand are likely to have influenced the location of many built environment features.

Lower rental costs may encourage businesses to locate in more deprived neighbourhoods (Pearce et al. 2008b). The proximity to appropriate workers is also an important consideration for new businesses (Rae 2005, Fernandez and Su 2004). For food outlets, the labour costs associated with running a business are a major factor in profits because much of what is being sold is produced on site (Nelson 2001). Costs are minimised by requiring fewer and less complex tasks which can be carried out by an unskilled labour force. As a result, locating in a neighbourhood which not only has access to such a labour force, but also provides more potentially affordable food to low income residents can result in a proliferation of businesses located within a small area. This increases the variety of food options available to residents within these high deprivation neighbourhoods and can influence consumption patterns.

Local planning initiatives can also influence the variety and quality of resources within a neighbourhood. Post-war development in western societies such as New Zealand placed considerable weight on greenfield development where many peri-urban or rural areas were transformed into large scale suburban developments (Field et al. 2004). Many of the major New Zealand cities have become shaped around the suburban rather than purely urban forms, copying the sprawl of cities in Australia and the US (Statistics New Zealand n.d). This resulted in rapid outward movement of people from the city centres, effectively changing patterns of community resource access from clusters of mixed use centres to separation of community, business, social and recreational activities (Saville-Smith 1999). The creation of these sprawling neighbourhoods increased reliance on automobile transport resulting in individuals without access to a car to be less likely to locate in these areas. Consequently, many of the traditionally designed neighbourhoods such as the Aranui area have become pockets of high

deprivation increasing this population's access to a variety of neighbourhood resources that can influence obesity.

7.4.2 The (Not In My Back Yard!) NIMBY effect

One final influence on the quality of environments must be mentioned here. The location of undesirable land use within a neighbourhood can influence the likelihood of individuals utilising neighbourhood resources through its reduction in providing aesthetically pleasing areas for individuals to engage in physical activity. The effects of community empowerment and NIMBY, or lack thereof, can be seen in two neighbourhoods analysed in this thesis.

High levels of community empowerment in a neighbourhood can lead residents to join together to change the environment they live in by making their opinions and desires heard (Kwate 2008). The success of NIMBY opposition is partly determined by the cohesiveness of the neighbourhood and the ability of neighbourhood residents to work together for a common outcome. Often areas with wealth, property, political power and connections are more capable of enacting desirable changes and preventing undesirable ones.

An examination by Coen and Ross (2006) of health-enhancing resources of urban parks in Montreal found that the visibility of industry in high health, low deprivation neighbourhoods was visibly reduced compared to high deprivation neighbourhoods. This relationship was also evident in the nine Christchurch neighbourhoods. Chapter Four introduced two neighbourhoods where potentially unwanted infrastructure is located alongside residential areas and local neighbourhood parks. Kyle Park in the

medium deprivation neighbourhood of Islington was first mentioned when examining the deprivation profile of the neighbourhood in section 4.4.1.3. This park is located within the most deprived portion of the neighbourhood right next to infrastructure such as cold storage facilities and a busy railway line. As many studies have shown that to encourage high levels of walking within a neighbourhood the environment must be aesthetically pleasing (Ball et al. 2001, Saelens et al. 2003, Berke et al. 2007), the presence of infrastructure that detracts from the surrounding environment and can potentially influence individual safety can result in a decrease in the number of individuals engaging in physical activity within these neighbourhoods.

Fear of potential health effects can also reduce the rates of physical activity. The presence of high tension power lines and a large electricity switching station in the Islington neighbourhood has the potential to influence physical activity patterns of neighbourhood residents. The presence of these facilities increases the level of electric and magnetic fields in the area which in some countries has been linked to an increased prevalence of certain kinds of cancer, especially in children (Ahlborn 2002, Draper 2005). Every few years, interest in the relationship between electromagnetic fields and cancer increases which can result in increased health concerns of individuals living near these facilities. Similarly, in the high deprivation Opawa neighbourhood, a number of smokestacks from industrial buildings are located amongst residential housing potentially influencing an individual's exposure to air pollution from both the buildings and heavy haulage trucks transporting the products. These two factors have the potential to reduce the likelihood that individuals will engage in physical activity within their own neighbourhood environment.

Research has shown that the closer residents are to an unwanted facility, the more likely they are to oppose it. Opposition usually runs high among those on the same block as the proposed facility however as little as two to six blocks away, neighbours' interest or awareness declines to the point of indifference (Dear 1992). The problem with this is that in high deprivation environments where there is little community empowerment and ability to enact change little can be done to prevent unwanted facilities locating in these neighbourhoods. As well as this, residents' ability to enact change and prevent such undesirable resources in their area may be superseded by promises of employment and the greater political power of large companies determined to build in these areas. Future planning measures focused on greater equality in urban design may reduce the burden these high deprivation neighbourhoods share and encourage more physical activity within such neighbourhoods

7.5 Perceptions of the neighbourhood

The second aim of this thesis was to examine how perceptions of a neighbourhood environment vary by deprivation and how these perceptions can influence utilisation of resources that may encourage or discourage obesity. This was undertaken through a questionnaire process in one neighbourhood of low, medium and high deprivation (Aorangi, Islington and Opawa respectively).

7.5.1 Defining a Neighbourhood

When conducting research examining neighbourhood effects on obesity, consideration must be given to the fact that the definition of a neighbourhood is interchangeable. Academically defined use of the word neighbourhood varies significantly from the subjective definition of a neighbourhood resident. Academic definitions of a

neighbourhood are usually administratively defined areas such as meshblocks for which there is population data readily available (Morland et al. 2002, Algert et al. 2006, Mujahid et al. 2008). This is compared to neighbourhood residents whose definition of their neighbourhood can be determined on the basis of their own use patterns (Stutz 1979, Hester 1984). The questionnaire developed for this thesis was designed to test this by examining what resources residents classified as being within their neighbourhood area.

Residents within the low deprivation Aorangi neighbourhood had the closest definition of a neighbourhood compared to the definition used in this thesis (an 800 metre Euclidean buffer around a chosen meshblock). This was largely a result of the presence of a large mall complex located just inside the 800 metre buffer area. From this, residents had access to a supermarket, cafes and restaurants and a number of takeaway outlets. A local bakery and butcher was also located within the neighbourhood, reducing the distance residents would have to travel to acquire fresh food. The presences of two large sports fields within this neighbourhood also provided a number of areas of physical activity. As a result, many of the everyday resources individuals require to maintain a healthy lifestyle were easily located within walking distance and reduced the need for a larger neighbourhood area.

The most obvious disparity between objective and subjectively defined neighbourhood areas was in the medium deprivation Islington neighbourhood. Residents continuously defined their neighbourhood as larger than an 800 metre area. When asked whether they had certain food resources within their neighbourhood, many residents stated that these were available from the local mall. This mall complex was located 1.2 kilometres

away from the centre of the neighbourhood area. Approximately a 25 minute walk away, this mall provided many of the resources that residents were unable to obtain with the smaller neighbourhood area creating a larger neighbourhood area based on the common use patterns of the residents.

These findings are largely a result of the location of the neighbourhood. The low deprivation Aorangi neighbourhood is located towards the centre of Christchurch in a high population density area. Alternatively the Islington neighbourhood is on the periphery of the city in a largely industrial, peri-urban neighbourhood. The distribution of community resources largely reflects the post-war change to separate use, suburban neighbourhoods. As a result, newer low-density suburban neighbourhoods like Islington which are located on the city fringes are likely to have lower levels of community resource access than older centres developed under mixed use planning models (Field et al. 2004). Also, as approximately half of this neighbourhood area consists of large industrial factories, the population density of the neighbourhood is not high enough to demand that resources locate here as many businesses look to maximise profits created by a larger population density (Nelson 2001) As a result, Islington residents must travel towards the centre of Christchurch where population demand for resources increases and urban design based on sprawl is less prevalent to obtain the resources they require.

These findings have important implications for the transport mode residents use to reach amenities within their neighbourhood. Research has shown that the furthest distance an individual will likely walk before altering their mode of transport is approximately 800 metres (Algert et al. 2006). As Aorangi residents are the most likely to perceive

that their neighbourhood is within an 800 metre area these residents are more likely to walk to the resource they need. This has important implications for obesity as research has shown that in cities that encourage walking and cycling as a mode of transport have better health statistics (Godfrey and Julien 2005) and were less likely to be obese (Saelens et al. 2003).

7.5.2 The Local Food Environment

Bearing in mind the larger definitions of a neighbourhood by residents, deprivation of the neighbourhood has an important influence on residents' utilisation of their neighbourhood resources. Residents in the higher deprivation neighbourhoods were more likely to perceive that shops were in easy walking distance of their home but less likely to think that there were healthy options for eating out in their neighbourhoods than Aorangi.

Perceived food availability is an important influence of the type of foods consumed within a neighbourhood (Inglis et al. 2008). While many studies have examined perceived safety and access to areas of green space as an influence of physical activity and obesity (Giles-Corti and Donovan 2002, Saelens et al. 2003, Timperio et al. 2005), few have looked at perceived access to food resources offered within a neighbourhood. Instead, there has been a greater focus on the presence or absence and density of certain resources based on the deprivation of the neighbourhood (Reidpath et al. 2002, Cummins et al. 2005b, Liu et al. 2007).

Examining the perception of food resources within the three neighbourhoods shows that Islington and Opawa are most likely to agree that shops are within easy walking

distance of their homes, but don't perceive that there are many healthy options for eating out in their neighbourhood. On top of this, Islington residents had the greatest perception that there were a number of fast food restaurants in their neighbourhood and that the lack of healthy food options made eating healthy more difficult.

One reason why both of these neighbourhoods may hold these perceptions is a result of their location in Christchurch. Figure 4.1 outlined the locations of each of the neighbourhoods in Christchurch. Both the Islington and Opawa neighbourhoods are located towards the outskirts of the city, with Islington being the most peripheral. This influences the number of available resources and the perceptions of neighbourhood residents as a result. Research by Inglis et al. (2008) has shown that socioeconomic differences in diet can be almost wholly explained by perceived food availability and accessibility. The perceptions of Islington residents that there are few healthy options and a greater number of fast food facilities available to residents can lead to consumption of a more unhealthy diet through the perception that there are few other options available. As a result, the medium deprivation Islington neighbourhood is more likely to promote obesity.

7.5.3 Green Space/Physical Activity

Research by Giles-Corti and Donovan (2002) examining perceived access to attractive open public space showed that individuals in low socioeconomic areas were 50% less likely to perceive that there were attractive public spaces available for use within their neighbourhood. The findings in this study are inconsistent with the international literature. They show that the residents in the high deprivation Opawa neighbourhood were the most likely to perceive that the neighbourhood offered many opportunities to

be active, there were many parks and playgrounds close to their home, and that there were easily accessible bicycle and pedestrian trails within their neighbourhood for physical activity. Having a park or area of green space within their neighbourhood was the most important to these residents. This discrepancy is largely a result of the greater urban design emphasis on green space. Part of the Greater Christchurch Urban Development Strategy is an increased emphasis on 'green networks', open space and 'green corridors' designed to provide and encourage walking and cycling (Christchurch City Council 2007). As a result, approximately 18% of the neighbourhood is dedicated towards green space, the highest of all three neighbourhoods participating in the questionnaire process. Research shows that those with increased access to large attractive areas of green space for physical activity are up to 50% more likely to achieve high levels of walking and physical activity within their neighbourhood (Li et al. 2004, Giles-Corti et al. 2005, Ellaway et al. 2005). Based on this, Opawa residents' perception that there are a number of areas to engage in physical activity can increase their use of these areas and reduce the likelihood of obesity.

7.5.4 Neighbourhood Safety

Finally, how safe an individual feels while out in their neighbourhood is also a significant influence on physical activity as studies show that perceived safety of the neighbourhood is an important predictor of being active (Booth et al. 2000, Pearce et al. 2007b, Stafford et al. 2007). Research has shown that residents in high walkability neighbourhoods have higher perceptions of safety from both crime and traffic than residents of low walkability neighbourhoods (Saelens et al. 2003). It has also shown that children whose parents were concerned about their safety were four times more likely to be obese (Timperio et al. 2005). As a parent's perception of whether it is safe

to play in the park or not is an important determinant of playground use and physical activity, (De Vaus and Wise 1996) creating an environment which promotes safety is an important determinant in reducing childhood obesity. Results from this study show no relationship between the walkability of the neighbourhood and the perception of safety.

Generally, international research has found that perceptions of crime and decreased safety are higher in more deprived neighbourhoods (Green et al. 2002, Weir et al. 2006). Results from the questionnaires about neighbourhood safety are inconsistent with these findings showing that deprivation does not seem to exert a strong influence on the safety of neighbourhood residents. In fact, residents in the high deprivation Opawa neighbourhood were most likely to perceive that the neighbourhood was safe for walking in both day and night, and that neighbourhood safety was not an influence on their physical activity levels.

This result is largely due to the effect of the wider neighbourhood environment. Participants were recruited from a meshblock of high deprivation; however the wider neighbourhood area also contains meshblocks of low to medium deprivation. Research has suggested that levels of crime in disadvantaged areas are lower in neighbourhoods where there are high levels of social cohesion (high interaction between residents and a strong sense of community) (Hirschfield and Bowers 1997). As social cohesion is generally higher in neighbourhoods of lower deprivation (Forrest and Kearns 2001), this may have some influence on residents' perception of safety. This may increase the level of physical activity of Opawa residents and reduce their propensity to be obese.

7.6 Mismatch between Actual and Perceived Neighbourhood Resources

Few studies have directly assessed the correspondence between perceived and objective measures. An understanding of the mismatch between perceptions and objective reality could be used to inform interventions aimed at educating the community about the availability of resource which promote a healthy lifestyle. One study assessed correlations between aggregate environmental factors (e.g. self reported access, walking/cycling ease etc) using a geographic information system and perceptions reported by adolescent males (Jago et al. 2006). Others have also found low levels of agreement between perceived and objective data on hills, weather and other environmental supports for physical activity (Troped et a. 2001, Kirtland et al. 2003, McGinn et al. 2007).

To date, only one study has examined the match between measures of physical activity facilities obtained through self-report and objective audit (Ball et al. 2008). This research found that there was relatively poor agreement between measures of access to physical activity facilities obtained via self-report and objective assessment (Ball et al. 2008). The perception that an amenity is available within a neighbourhood is largely based on an individual's own use patterns; if someone never uses a certain amenity, then they are less likely to perceive that it exists within their neighbourhood area.

Results from this study are inconsistent with international literature and indicate that measures of access to built environment resources between self-report and objective assessment are relatively accurate. One reason for this may be that the study by Ball et al. (2008) defined a neighbourhood as within 2 kilometres of the participant's home.

The smaller 800 metre definition of a neighbourhood area used in this thesis may mean participants had a greater awareness of what their neighbourhood contained.

The most obvious mismatch between perceived and actual resources was in the medium deprivation Islington neighbourhood. Of all three categories of questions asked (food resources, green space resources and neighbourhood safety) the largest mismatch between perception and actual resources was in the food category. Neighbourhood residents believed that they had access to a number of shops in their neighbourhood, there were a number of healthy options for eating out in their neighbourhood, and that there were many fast food restaurants in their neighbourhood. These statements only became true once defining their neighbourhood as a minimum 1.2 kilometre area.

As the majority of residents within the three neighbourhoods have a mostly accurate perception of the amenities available in their local neighbourhood, the perception of the time it takes to reach a resource may be the largest indicator of its use. The perception that certain neighbourhood resources will take a long time to reach can do one of two things; it will either encourage residents to change their food choice to a closer amenity, or encourage the use of short car trips within the neighbourhood to reach the original resource. Time spent in a car as either a passenger or driver is positively associated with obesity with an additional sixty minutes per day in a car translating to an additional 6% odds of being obese (Frank et al. 2004). As the furthest distance an individual will likely walk before changing their mode of transport is 800 metres, (Pearce et al. 2008b) a distance which takes approximately ten minutes to walk, the perception that certain resources are further away from this may encourage greater automobile use.

The neighbourhood most likely to encourage these small car trips is Opawa as supermarkets, fast food restaurants and full service restaurants were all perceived as more than ten minutes walking distance away from individual's homes. Combined with this, as a result of the Avon River running through the neighbourhood, the road network is more consistent with a sprawling neighbourhood rather than traditional grid pattern networks. This increases the time it takes to reach an amenity as there is no direct path available and will increase the likelihood that individuals will use an alternative means of transport than walking. Encouraging a higher mix of land uses may be a solution to this as access to a number of different resources within an individual's neighbourhood may reduce the time it takes to reach the desired resource and increase the number of people walking rather than driving to it.

7.7 Implications of the Research

The results of this study suggest that high deprivation neighbourhoods in Christchurch are less likely to promote obesity. This finding is inconsistent with much of the international literature which states that access to, and quality of resources is lower in higher deprivation neighbourhoods (Macintyre et al. 1993, Coen and Ross 2006, Seliske et al. 2009). Levels of obesity have consistently been shown to be greater in neighbourhoods of low socio-economic status and high deprivation (Kopelman 2000, MOH 2006b). Should the built environment and quality of resources have an effect on obesity in Christchurch, rates of obesity within these high deprivation neighbourhoods would be expected to be lower as individuals have access to better quality resources than low deprivation neighbourhoods. This study suggests that there may be a number of causes for the geographic variation of obesity, of which the effects of the built environment is only one.

It also highlights that idea that context is important when examining the influence of the built environment. The historical development of the city in question can have a large influence on the design of built environment features within a neighbourhood. The development of city-specific planning initiatives can increase or decrease the influence of the built environment on obesity. For example, the greater focus on providing a wide variety of green space areas within Christchurch ensures that individuals have access to a number of areas for physical activity regardless of their socioeconomic status.

Size of the city is also important. Much of the research that finds a relationship between built environment resources and obesity has been conducted in cities much larger than Christchurch. As a result, populations with similar characteristics cluster together and experience greater segregation from others which may influence their access to resources. In Christchurch, population deprivation is highly mixed with neighbourhoods consisting of a number of different deprivation categories. While the influence of the built environment may not be as important in Christchurch, its role in influencing obesity should not be marginalised. This study suggests that both compositional and contextual factors are important to understand obesity variation.

7.8 Limitations of Research

While the results of this thesis can have important implications for understanding the influence of the environment on obesity, the study's limitations need to be considered. First, while the development of the site survey tool used to examine the quality of available resources within a neighbourhood was based on other tested survey tools, judging the quality of the neighbourhood was based on the subjective decisions of one

observer. While many of these studies often employ at least two observers rating independently of each other to test the reliability of the survey tool, (Weich et al. 2001, Caughy et al. 2001, Lee et al. 2005) given the scope of this project, multiple examiners were not an option.

Second, the analysis of abundance and location of facilities using Euclidean buffers is problematic because in some urban areas nearby roads may not be connected due to the layout of the street network, or because of physical features such as high topography, tidal flats or bodies of water (Witten et al. 2003, Pearce et al. 2006). Future research could use more sophisticated GIS measures of neighbourhood accessibility that calculate distance through the road network rather than the Euclidean measurements used in this study.

Third, this study is relying on the assumption that residents will mostly use resources located within their own neighbourhoods. It does not account for residents' ability to engage in physical activity or procure food outside of their own neighbourhoods, for example, in the vicinity of their workplace or school. Similarly, residents' perceptions of the extent and scope of their neighbourhood can differ from the distance-based definitions used in this study, a limitation that was potentially resolved by employing a number of different size buffers as a definition of a neighbourhood. This research has also not examined the role that local school grounds and playgrounds play in encouraging physical activity which is an important and under-recognised role within a community (Lee et al. 2005).

Finally, given the scope and time frame of this research, only nine neighbourhoods were chosen to examine the quality of neighbourhood resources influencing obesity. As a result, assumptions are made about all neighbourhoods of a given deprivation on the basis of the findings of this study. It is important to note that the results are in part a product of a meshblock of a given deprivation located within a wider environment which may influence the variety, quality and utilisation of resources influencing obesity.

7.9 Policy Implications of the Research

Reducing the prevalence of obesity is one of the priority objectives in the New Zealand Health Strategy (MOH 2000). Numerous documents have been written to address the obesity epidemic including *Healthy Eating Healthy Action: A strategic framework and implementation plan* (MOH 2003b), and the *Food and Nutrition Guidelines* (MOH 2003d). These documents provide frameworks to assist the health sector reduce the rates of obesity in New Zealand. Despite these frameworks, obesity prevalence is still rising suggesting that individual factors may not be solely responsible for determining obesity levels. The results of this study suggest that both compositional and contextual factors are important in explaining obesity variation, and as a result, considering the role of the built environment is important.

Understanding how present day neighbourhoods encourage or discourage obesity can provide a framework for the creation of new neighbourhoods as the population increases and expands outwards. Generally these older, traditionally designed, high deprivation neighbourhoods had a greater focus on increased land use mix, grid pattern road systems and high quality physical activity resources. This suggests that a shift back to the traditional ideas of neighbourhood design with a focus on mixed land use, access to

healthy food and physical activity resources may help reduce the potential prevalence of obesity within a neighbourhood. Internationally, emphasis is already being placed on designing and creating neighbourhoods that have a focus on increasing walkability, access to a number of varied land uses, healthy food resources and physical activity opportunities (Ashe et al. 2007, Eid et al. 2008).

One of the best examples to base a newly designed neighbourhood on is the St Albans neighbourhood. This neighbourhood scored the highest of all individual neighbourhoods because of its emphasis on grid pattern street networks which reduces the extent of urban sprawl. As a result, residents within this neighbourhood can easily walk to a number of locations before having to resort to an alternative mode of transport. The neighbourhood also provides a mixture of different uses with residents having access to commercial, recreational, cultural, industrial and residential zones. The implementation of these newly designed neighbourhoods would have the greatest effect over a longer period of time as it relies on the expansion of the population to a point where new suburbs and neighbourhoods are necessary.

The New Zealand Health Strategy was first introduced in 2000. This document sets the platform for government action on health and identifies priority areas to ensure that health services are directed at those areas that will ensure the highest benefits for the population, focusing in particular on tackling inequalities in health (MOH 2000). One of its thirteen priority objectives is to reduce the prevalence of obesity. The strategy aims to focus on the use of prevention strategies as a means of reducing health inequalities. At present, its efforts to reduce obesity involve a stock take of the current obesity prevention programs in New Zealand as well as successful international

programs. Opinions about whether these types of campaigns work is divided, with some stating that they have changed social opinions and attitudes (Smith 2002, Booth et al. 1992, Cavill and Bauman 2004), to those claiming that these campaigns have little or no effect (Sowden and Arblaster 2000, Glantz and Mandel 2005). A greater focus on the role of the environment as well as the use of other prevention strategies may be more effective in reducing inequalities in obesity prevalence. The strategy states that tackling the determinants of health inequalities requires action across sectors to create supportive environments for health. Therefore, understanding the influence of the built environment in creating environments conducive to healthy lifestyles can potentially benefit large numbers of the population.

A second initiative that the findings of this research could benefit is the Healthy Eating Healthy Action Strategy. This initiative aims to address poor nutrition, lack of physical activity and obesity in response to the New Zealand Health Strategy. This initiative has a greater focus on the need for environmental support and the need to promote and foster environments that support healthy lifestyles. As a result, a number of District Health Board initiatives have been developed that create healthy environments which support better nutrition and physical activity. Awareness that the quality of the environment is as important as the presence of certain amenities can assist initiatives in influencing a greater number of the population. As many of the initiatives focus on educating sections of the population about better nutrition, an understanding of the types and quality of food resources available within local neighbourhood areas can help target initiatives towards specific at risk populations.

A final implication of this research is the need to focus on changing the public perception of their neighbourhood. The study by Ball et al. (2008) examining the perceived versus actual physical activity resources within a neighbourhood showed that generally participants were unaware of many of the resources available within their neighbourhood. This was also the case in this study, with many participants incorrectly perceiving access, time and distance to a number of obesity influencing resources within their neighbourhood. The perception that a resource is unavailable or too far to travel to can influence its use. To counter this, increased emphasis on educating people as to where local healthy resources are located, or where they can engage in physical activity may increase the utilisation of these resources and have some effect on obesity within specific neighbourhood areas.

7.10 Conclusion

This chapter has discussed the findings of this thesis in relation to the national and international literature. Results of this research found that as the deprivation of a neighbourhood increased, so too did the overall quality of the available resources within that neighbourhood. Based on this, high deprivation neighbourhoods were most likely to reduce obesity at a neighbourhood level. This finding contrasted that of many of the international studies examining access to and quality of resources by deprivation. It was consistent with past research conducted in New Zealand that found that access to both food and physical activity resources increased as deprivation increased.

This chapter also examined the influence of neighbourhood perceptions on utilisation of resources and found that the high deprivation neighbourhood of Opawa had the most accurate perceptions of the availability of resources, distance and time it took to reach

them. This would be likely to impact on their use, increasing utilisation of the local resources and potentially decreasing obesity within this neighbourhood.

Despite its limitations, this research has a number of important implications. The study suggests that the influence of the built environment is context specific and that both individual and environmental factors need to be considered when explaining obesity variation. An understanding of the built environment influence can benefit the current health initiatives directed at reducing obesity and have an important role in reducing the obesity prevalence.

Chapter Eight
Conclusion

8.1 Introduction

The rise of obesity is becoming a considerable problem in many countries and New Zealand is no exception to this. The research presented in this thesis was designed to extend the understanding of environmental influences on obesity and to determine whether the quality of resources within a local neighbourhood can shape the prevalence of obesity. The findings have been described in the context of New Zealand and wider international research. The purpose of this final chapter is to summarise the key themes of this research and to discuss future research ideas stemming from this study. This chapter begins by briefly revisiting the objectives of the study and how these objectives were addressed. The subsequent section discusses the two central themes identified by this research. Finally, a number of future research directions to extend the examination of obesogenic environments in New Zealand are identified.

8.2 Thesis Objectives Revisited

The purpose of this study was two-fold: to examine the influence of neighbourhood deprivation on the availability and quality of the major built environment resources that influence obesity; and to investigate how neighbourhood residents' perception of their local food resources, green space and crime and safety varies by deprivation as an influence of consumption and physical activity levels.

These aims were considered important for a number of reasons. First, obesity prevalence is increasing in many countries worldwide, but the exact cause remains unclear. Second, the role of the built environment has been implicated in increasing geographical inequalities in obesity prevalence, but previous studies have focused on deprivation as an influence on presence or absence of obesity inducing features. Little is known about how the quality of these built environment features can influence obesity. Even less is known about how residents' perception of their neighbourhood environment can influence resource utilisation and the likelihood of obesity. Finally, this issue has not been adequately assessed in New Zealand, a country facing a potential obesity epidemic.

To address both aims, a range of quantitative and qualitative methods were employed. A systematic site survey tool was developed to objectively assess seven categories of the built environment to examine how the quality of resources varies by neighbourhood deprivation. Objective measures of neighbourhood connectivity, green space and walkability were used to test the results of the survey tool. Neighbourhood perceptions were assessed using a five point Likert Scale questionnaire. Chi square tests were utilised to assess the relationships between neighbourhood perceptions and deprivation. The findings of these analyses have highlighted two key themes which will each be addressed in turn.

8.3 Summary of Key Findings

The results from this study contribute to the growing body of research examining the role of the built environment in influencing obesity variation. The most important

finding from this thesis is that both compositional and contextual explanations are important in explaining the increasing prevalence and geographic variation of obesity.

8.3.1 Neighbourhood Resource Access and Quality

This study adds to the evidence that the quality of resources varies significantly in different neighbourhoods and that examining quality is as important as access to resources. Moreover, it contributes to a growing body of evidence that additional research examining the design and focus of New Zealand neighbourhoods is needed as built environment relationships consistently differ from international findings. These findings suggest that a greater focus on the urban design of neighbourhoods could create healthier neighbourhoods and influence the geographic variation in obesity prevalence.

Neighbourhood deprivation showed a significant relationship with the total count, access and quality of resources within the nine neighbourhoods examined. A significant non-linear relationship existed between the count of healthy and unhealthy food resources and deprivation suggesting that the availability, and as a result access, to any kind of food resource is patterned by deprivation. Medium deprivation neighbourhoods had the greatest access to resources with healthy food resources outweighing unhealthy resources by almost a 2:1 ratio.

Examination of the quality of resources by overall deprivation category showed that as neighbourhood deprivation increased the average quality of neighbourhoods also increased. This was a finding inconsistent with the international literature as previous studies employing similar methods have found that quality of the environment decreases as deprivation increases (Lee et al. 2005, Coen and Ross 2006). However, given that

research conducted in New Zealand has found that higher deprivation neighbourhoods have better access to green space and food resources such as supermarkets (Field et al. 2004, Pearce et al. 2007b, Pearce et al. 2008a), the finding that resource quality increases as deprivation increases is not unexpected. This result was further supported by the objective measures that found that neighbourhood connectivity, access to green space and walkability displayed a positive relationship with increasing deprivation. An explanation for the preceding findings examines the role of planning initiatives and the creation of large scale decentralized suburban developments. Consequently, reliance on automobile transport effectively sorted neighbourhood socioeconomic position with low income individuals consequently locating in the more traditionally urban designed neighbourhoods. As a result, high deprivation neighbourhoods have better quality resources which may be more conducive to a healthier environment and can influence the prevalence of obesity in this population.

8.3.2 Residents' Perception of their Neighbourhood

As residents' perception and knowledge of their environment can influence how they interact within it, understanding the varying perceptions plays an important role in future resource allocation. This research suggests that understanding how residents perceive their environment can have important implications for resource utilisation. Results from this thesis suggest that an individual's perception of the size of their neighbourhood differs considerably from the academic literature and that this can have an important influence on their utilisation of certain resources. An examination of the extent that neighbourhoods vary would provide greater understanding of individual use patterns and how this can increase the utilisation of resources known to reduce obesity.

The finding that the high deprivation neighbourhood was the most likely to perceive their neighbourhood favourably contrasts international literature which suggests that residents in a low income, high deprivation neighbourhood are more likely to perceive that they do not have access to required resources (Giles-Corti and Donovan 2002, Inglis et al. 2008). It also suggests that providing a number of areas to engage in physical activity and a wide variety of food resources is an important step in increasing awareness of the resources available within a neighbourhood. This research highlights that it is not just the quality or availability of resources within a neighbourhood that is important in reducing obesity, but also the way in which the neighbourhood and resources are perceived by those using them.

8.4 Future Research

Investigation into the role that the environment plays in influencing obesity is receiving increasing attention in an attempt to slow what is becoming a considerable problem throughout much of the world. The research provided in this thesis attempts to help understand how neighbourhood environments and their resources influence the potential for obesity. There are however, several key areas that warrant further investigation, especially in the New Zealand context.

The results of much of the international literature examining neighbourhood effects on health and obesity can be largely determined by the methods and location that the research is undertaken. As a result, the study provides a snapshot of the neighbourhood environment in one small area. It would be wrong to assume that the relationships appear in this study hold true for other areas in New Zealand as the planning and history of each city has an important influence on the way neighbourhoods are designed. As a

result, future research could examine a wider variety of neighbourhoods in Christchurch, and neighbourhoods from other areas of New Zealand to examine if there is any change in local versus national trends.

On a similar note, this study has examined neighbourhoods of only three deprivations (low, medium and high) as these neighbourhoods often are the most contrasting and assumes that the relationships found from examining the quality of resources are linear. Examination of the quality of resources in neighbourhoods of alternative deprivation levels may highlight other important relationships in understanding the influence of the environment on obesity.

Undertaking this task on a larger scale would be a time and person intensive approach to visit each neighbourhood in an area while using the systematic site survey to rate the quality of the available neighbourhood resources. Google Streetview was first launched in New Zealand in December 2008 and is a tool which provides 360^{o} horizontal and 290^{o} vertical panoramic views of many of the streets in major cities of New Zealand enabling users to see locations as if they were standing on the street itself (Google 2009). The images are gathered by vehicles equipped with advanced imaging technology driving on public roads. A potential area of future research could be to examine the effectiveness of using imaging tools such as Streetview to undertake large scale examination of the quality of neighbourhood environments.

The results from this thesis are based on relationships found in both the international and national literature, and as a result it uses these relationships to infer the prevalence of obesity based on the existence of certain amenities in that neighbourhood. A further

test of the validity of using features of the built environment to predict obesity levels may be to test the actual prevalence of obesity versus the quality of neighbourhood once controlling for individual variables such as ethnicity or age. Should the actual level of obesity be lower in neighbourhoods of higher quality, planning measures could be adopted to ensure all neighbourhoods provide resources of a minimum quality standard.

The final area where future research could aid understanding of neighbourhood effects on obesity is subjective perceptions of the local neighbourhood. This thesis has outlined the arguments examining the varying idea of what constitutes a neighbourhood, yet there is little research examining the difference between the objective and subjective definitions. This can be rectified if a similar study was to be conducted in other neighbourhood areas. By asking interview participants to outline their neighbourhood area on a map this can be compared to academic definitions of a neighbourhood. Understanding the size of perceived neighbourhoods can also help to locate high quality resources within certain under-represented areas which may increase resource utilisation and reduce the obesity prevalence.

8.5 Concluding Statements

It is estimated that approximately 285 deaths per year could be avoided from 2011 as a result of a small reduction and BMI and effective policy changes (Mhurchu et al. 2005). As individual level characteristics have not been completely successful in explaining obesity variation, understanding of the role of the environment is important. Examination of the role of the environment on obesity in New Zealand is slowly increasing, and this thesis has contributed to that knowledge.

This research reveals that the wider context of the environment is important in influencing the relationship between the built environment and obesity. Awareness of how neighbourhoods vary in both the availability of resources and their quality is also important. Furthermore, examining the prevalent perceptions of these neighbourhoods can provide insight into individual activity patterns and utilisation of obesity reducing resources. This study highlights the need to consider both environmental and individual explanations for the geographic variation of obesity. While these conclusions require further investigation, any clues towards the drivers of health inequality and obesity prevalence is worthwhile due to the increasing burden of disease caused by high levels of obesity in New Zealand.

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Appendices

Appendix One: Site Survey Tool used to examine quality of resources

Site Survey Checklist Coded Results

Neighbourhood Name:

Urban Sprawl

										Score
1	Is the dominant housing type single family?	Yes	**(0)**	Mostly	**(1)**	No	**(2)**			
2	Is the dominant housing type apartments?	Yes	**(2)**	Mostly	**(1)**	No	**(0)**			
3	Are housing sections large eg ¼ acre	Yes	**(0)**	Mostly	**(1)**	No	**(2)**			
4	Are there many cul-de-sacs	None	**(2)**	Some (5-10)	**(1)**	Many (>10)	**(0)**			
5	Development Density									
	TOTAL									**/8**

Comments:

Road Connectivity

6	Is the neighbourhood a high traffic area? (traffic is constantly flowing)	Yes	**(0)**	No	**(1)**					
7	What is the average distance between intersections									
	TOTAL									**/1**

Comments:

Environment Walkability

8	Are the sidewalks clear of obstruction? (free of debris and cracks in sidewalk)	Yes	**(2)**	Mostly	**(1)**	No	**(0)**			

9	Is shade provided for walking?	Yes	**(2)**	Some	**(1)**	No	**(0)**		
10	Has the area been landscaped?	Yes	**(2)**	Some	**(1)**	No	**(0)**		
11	Is it easy to cross roads in the neighbourhood? (crossings etc are provided)	Yes	**(2)**	Some	**(1)**	No	**(0)**		
12	Is there a green strip protecting pedestrians from the road?	Yes	**(2)**	Some	**(1)**	No	**(0)**		
13	Does the area provide a number of destinations to walk to?	Yes (more than 10)	**(2)**	Some (1-10)	**(1)**	No	**(0)**		
	TOTAL								**/12**

Comment:

Mixed Landuse

14	Does the neighbourhood have mixed landuse?	Yes	**(1)**	No	**(0)**				
15	Is the neighbourhood mostly residential zoning?	Yes	**(1)**	No	**(0)**				
16	Does the neighbourhood include recreational zoning	Yes	**(1)**	No	**(0)**				
17	Does the neighbourhood include business zoning?	Yes	**(1)**	No	**(0)**				
18	Does the neighbourhood include industrial zoning	Yes	**(1)**	No	**(0)**				
19	Does the neighbourhood include cultural zoning	Yes	**(1)**	No	**(0)**				
	TOTAL								**/6**

Comments:

Food Environment

20	Does the neighbourhood at least one supermarket?	Yes	**(1)**	No	**(0)**				
21	Number of takeaways in neighbourhood	0-5	**(3)**	6-10	**(2)**	11-15	**(1)**		
22	Number of restaurants in neighbourhood	0-5	**(0)**	6-10	**(1)**	More than 10	**(2)**		
23	Does the neighbourhood have at least one fruiterer or butchery?	Yes	**(1)**	No	**(0)**				
24	Is there access to convenience stores/bakeries/dairies/petrol stations	0-5	**(2)**	6-10	**(1)**	More than 10	**(0)**		
	TOTAL								**/9**

Comments:

Green Space/Physical Activity

25	Is there access to green space and areas of physical activity in the neighbourhood?	Yes (>5)	**(2)**	Some (1-5)	**(1)**	No	**(0)**				
	Playgrounds	N/A									
26	Is there access to a playground for children?	Yes	**(1)**	No	**(0)**						
27	If children are playing in the playground, are they supervised?	Yes	**(1)**	No	**(0)**	N/A					
28	Has the area been landscaped?	Yes	**(2)**	Some	**(1)**	No	**(0)**				
29	Have public toilets been provided in the playground?	Yes in all playgrounds	**(2)**	Some	**(1)**	None	**(0)**				
30	Are these in a sanitary condition?	Yes	**(1)**	No	**(0)**						
31	Does the playground provide separate play sets for different age groups?	Yes	**(2)**	Some	**(1)**	No	**(0)**				
32	Are the playground structures safe to play on	Yes	**(1)**	No	**(0)**						
33	Dominant structure material	Plastic	**(3)**	Wood	**(2)**	Rope	**(1)**	Metal	**(0)**		
34	Type of ground surface material	Concrete/asphalt	**(0)**	Grass	**(2)**	Wooden mulch/ woodchips	**(3)**	Gravel/ Sand	**(1)**		
35	Quality of ground surface	Poor: uneven ground surface/lots of spots to twist ankles	**(0)**	Adequate: some imperfections in ground surface/few uneven spots	**(1)**	Excellent:	**(2)**				
36	Are the play structures secured to the ground adequately?	Yes	**(1)**	No	**(0)**						
37	Is the area well lit?	Yes	**(2)**	Partially	**(1)**	No	**(0)**				
38	Is seating provided for parent supervision?	Yes	**(2)**	Some	**(1)**	No	**(0)**				
39	Are rubbish bins provided and well maintained?	Yes	**(1)**	No	**(0)**						
40	Is the playground surrounded by a high traffic road network?	Yes	**(0)**	No	**(1)**						
41	Is the park free from harmful waste? eg syringes	Yes	**(1)**	No	**(0)**						
	Sports Fields	N/A									
42	Is there a sportsfield in the neighbourhood	Yes	**(1)**	No	**(0)**						
	TOTAL										**/27**
43	Have public toilets been provided	Yes	**(1)**	No	**(0)**						
44	Are these in a sanitary condition?	Yes	**(1)**	No	**(0)**						
45	Does the sportsfield provide for more than one sport? (eg rugby and soccer)	Yes	**(1)**	No	**(0)**						

46	Is the area well lit?	Yes	**(2)**	Partially	**(1)**	No	**(0)**		
47	Has the area been landscaped?	Yes	**(2)**	Some	**(1)**	No	**(0)**		
48	Is seating provided for spectators?	Yes	**(2)**	Some	**(1)**	No	**(0)**		
49	Are rubbish bins provided and well maintained?	Yes	**(1)**	No	**(0)**				
	TOTAL								**/10**
	Pay Facilities								
50	Is there access to a pay facility eg gyms	Yes	**(1)**	No	**(0)**				
51	Is the access to and from the facility adequately lit?	Yes	**(1)**	No	**(0)**				
	TOTAL								**/2**

Comments:

Crime and Safety

52	Is there a neighbourhood watch group set up?	Yes	**(2)**	Only on some streets	**(1)**	No	**(0)**		
53	Is there adequate street lighting?	Yes	**(1)**	No	**(0)**				
54	Presence of grafitti?	Yes	**(0)**	No	**(1)**				
55	Has grafitti been painted over?	Yes	**(1)**	No	**(0)**				
56	Are there signs of vandalism in the area?	Yes	**(0)**	No	**(1)**				
57	Presence of litter	Large amount of debris/litter/very unclean	**(0)**	Moderate amount of litter/debris	**(1)**	Ground surface is mostly free of litter	**(2)**		
58	Are there abandoned cars/buildings/broken windows?	Yes	**(0)**	No	**(1)**				
59	Are there speed humps to slow traffic?	Yes	**(1)**	No	**(0)**				
60	Are there traffic speed limitations below the normal speed? eg 20km/hr	Yes	**(1)**	No	**(0)**				
61	Are recreational areas overlooked by properties?	Yes	**(1)**	No	**(0)**				
	TOTAL								**/12**

Comments:

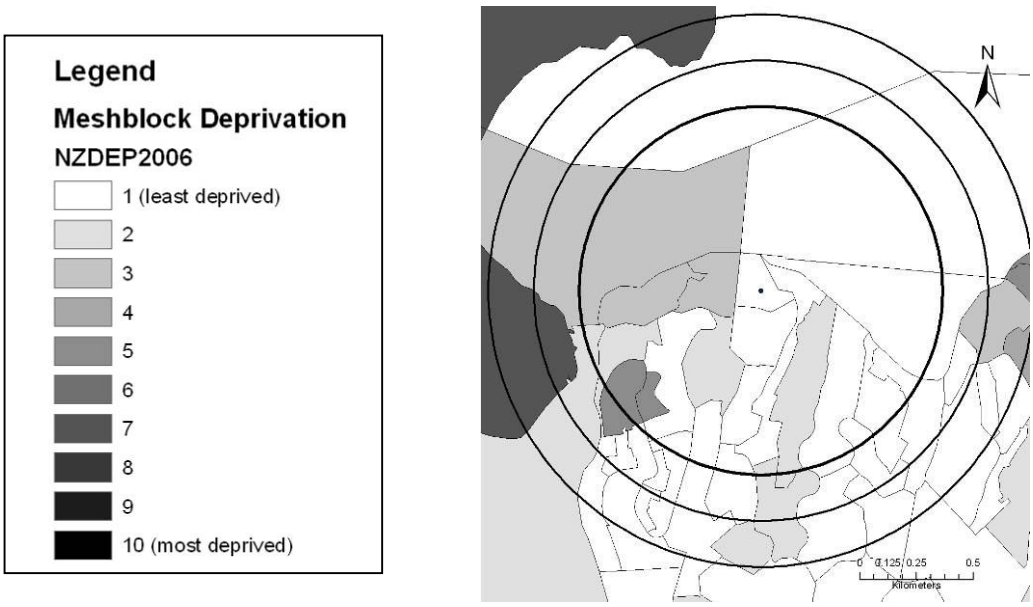
TOTAL SCORE FOR NEIGHBOURHOOD	
PERCENTAGE	

Appendix Two: Deprivation Profiles and Local Neighbourhood Resources

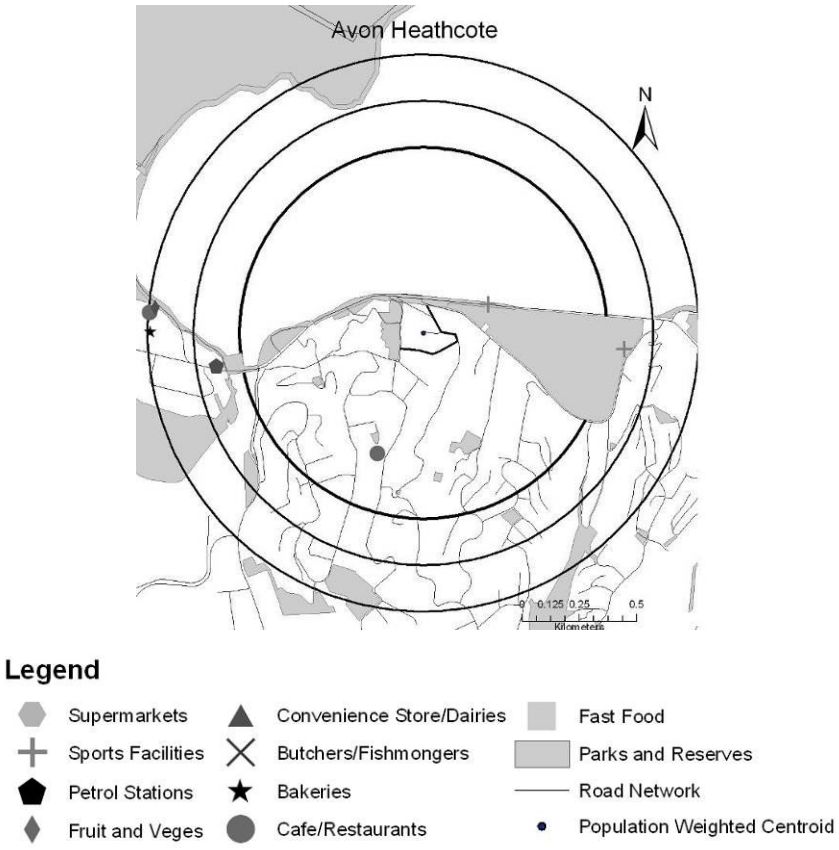
Avon Heathcote (Low Deprivation)

This neighbourhood is the least deprived of all nine neighbourhoods examined in this thesis (Appendix 2.1). The majority of the neighbourhood is very low deprivation with the most deprived meshblock in this neighbourhood being a deprivation five. The small areas of medium deprivation in this neighbourhood are a result of commercial infrastructure located at the edge of the estuary area.

This neighbourhood differs vastly from others in this study due to its lack of most resources (Appendix 2.2). While the presence of the Avon Heathcote Estuary and McCormacks Bay Reserve covering half the neighbourhood provides a more diverse range of recreational areas than other neighbourhoods in this study, it also reduces the total potential population able to reside within the neighbourhood area. This may limit the number of resources located in the neighbourhood as demand may not be high enough for the provision of these resources. As a result the neighbourhood provides only one café/restaurant for the entire neighbourhood. This may also be due to the fact that this area is a low deprivation, affluent neighbourhood with prime views of the estuary and the surrounding areas. Due to this, decisions by residents to settle in this area may be more of a lifestyle choice rather than local amenity based. The inclusion of a 1.2 kilometre buffer shows that residents would have to travel at least this distance to reach healthy food resources which may influence their perception of neighbourhood area.



Appendix 2.1: Deprivation profile of the low deprivation Avon Heathcote neighbourhood

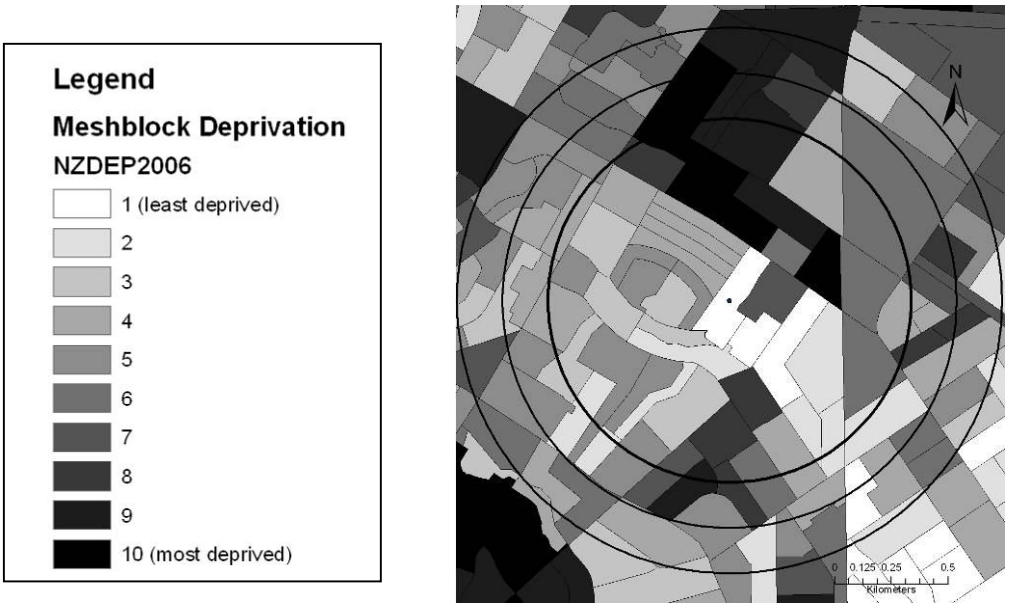


Appendix 2.2: Map of Avon Heathcote neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

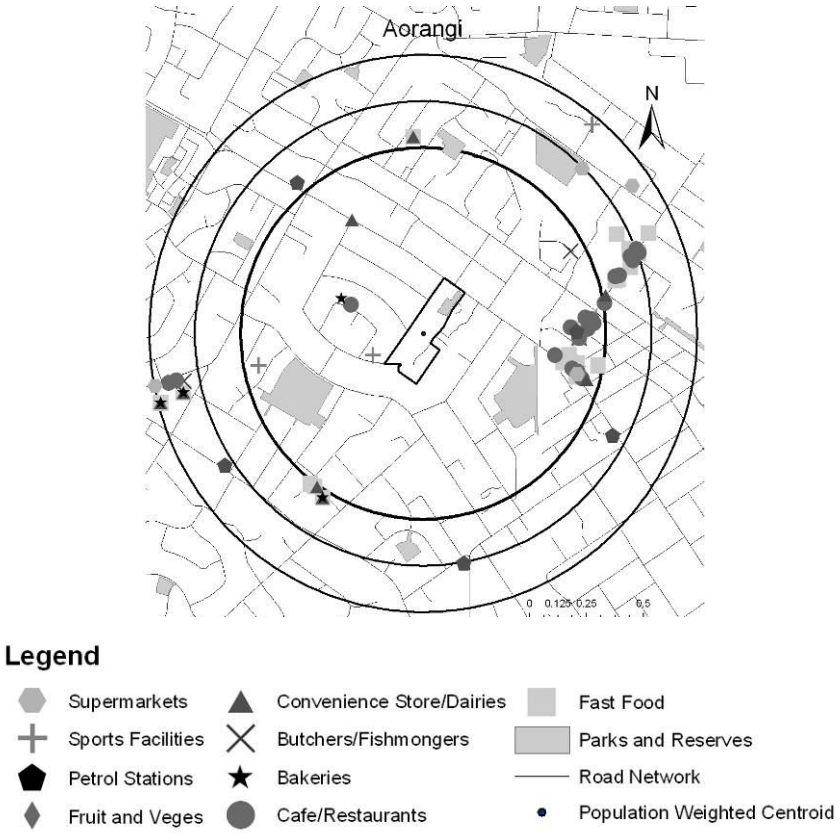
Aorangi (Low Deprivation)

This neighbourhood is predominantly low deprivation (Appendix 2.3). However, there is a variation in the deprivation of other meshblocks within the neighbourhood. The most obvious division is through Harewood Road where the predominantly low deprivation mesh blocks are separated from the high deprivation mesh blocks. Many of these higher deprivation neighbourhoods contain housing estates which will influence certain characteristics of the population within this neighbourhood

Residents within this neighbourhood have access to at least five areas of green space which is distributed fairly evenly within the neighbourhood, providing residents with easy access to at least one area for physical activity nearby (Appendix 2.4). Considerable effort has been taken in this neighbourhood to provide an aesthetically pleasing neighbourhood for walking. Many of the streets have been landscaped, with a select few also providing shade for walking. The neighbourhood itself has a considerable spread of food resources available although the spatial placements of these are not even. The clustering of resources in the eastern section of the neighbourhood is a result of a mall complex, which while providing a supermarket as a healthier food option, also creates access to a food court and numerous fast food restaurants. The addition of a one kilometer and 1.2 kilometre buffer slightly increases the number of resources within the neighbourhood, especially near Grahams Road in the lower left of the neighbourhood, however, as most food resources are catered for within the mall area, a larger neighbourhood area is not as important as residents have access to all of the food resources they need within an 800 metre neighbourhood.



Appendix 2.3: Deprivation profile of the low deprivation Aorangi neighbourhood

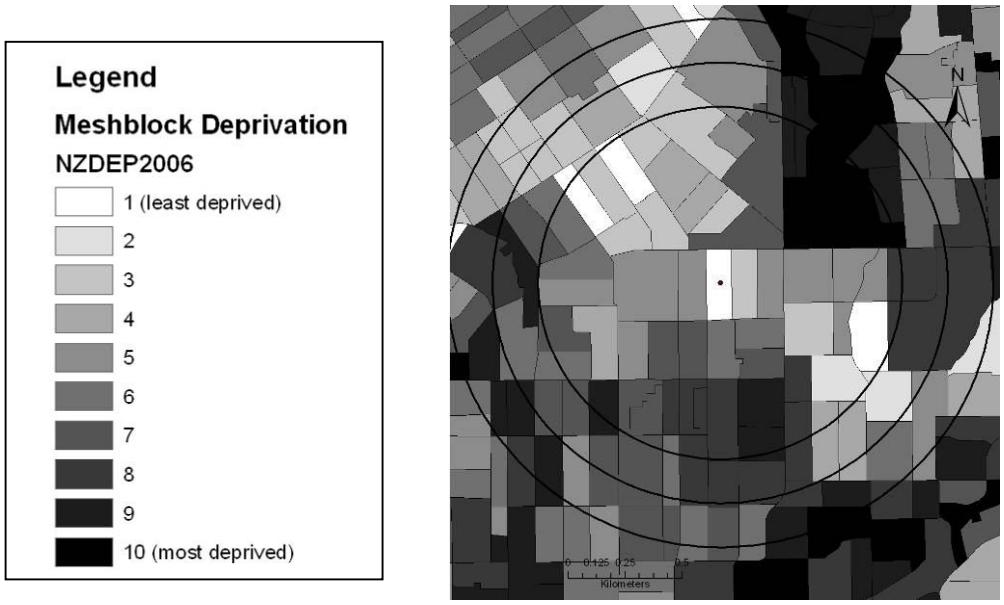


Appendix 2.4: Map of Aorangi neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

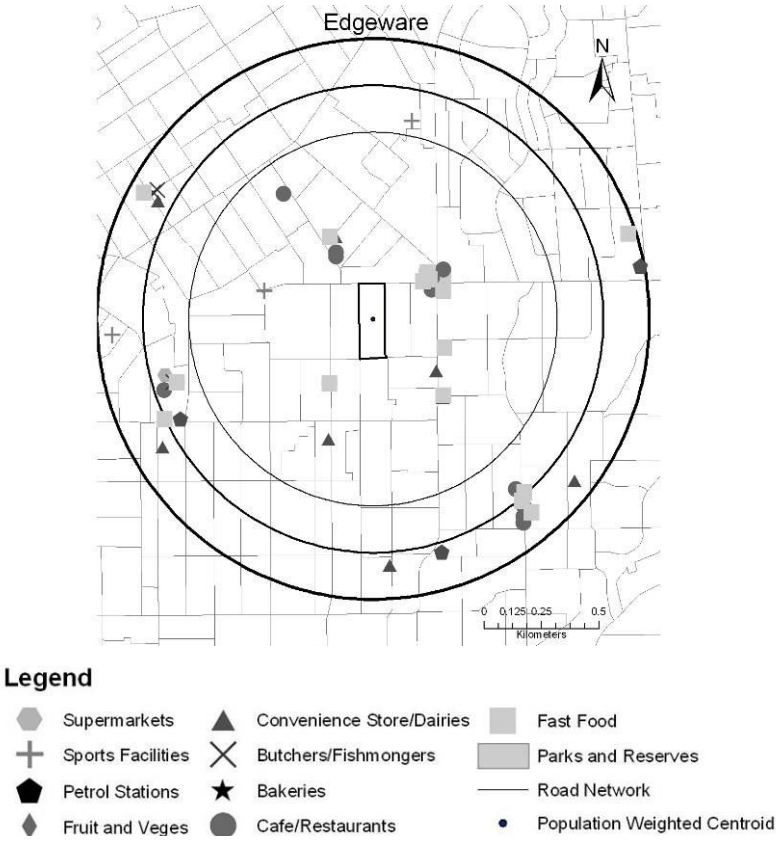
Edgeware (Medium Deprivation)

While this neighbourhood was originally selected on the basis that the mesh block was a low deprivation one category, the deprivation of the wider neighbourhood is more consistent with a medium deprivation category (Appendix 2.5). Although there are pockets of low deprivation, the neighbourhood is mostly comprised of medium to high deprivation mesh blocks. The majority of resources within this neighbourhood are located within these medium deprivation mesh blocks.

Areas of physical activity are located fairly uniformly across the neighbourhood with the presence of a large sports field close to the centre of the neighbourhood increasing the likelihood of individuals participating in physical activity (Appendix 2.6). The amenities are clustered into small areas indicating the presence of a number of small shopping centres within the neighbourhood. Residents have access to a wide variety of resources, however the absence of a supermarket means residents have to travel outside the neighbourhood area to access healthier food options. The inclusion of a one kilometre or 1.2 kilometre buffer has a greater effect in this neighbourhood largely due to the proximity to the CBD, resulting in an increase in accessible food resources especially around Cornwall Street and Stanmore Road in the lower left and right quadrants of the neighbourhood.



Appendix 2.5: Deprivation profile of the medium deprivation Edgeware neighbourhood

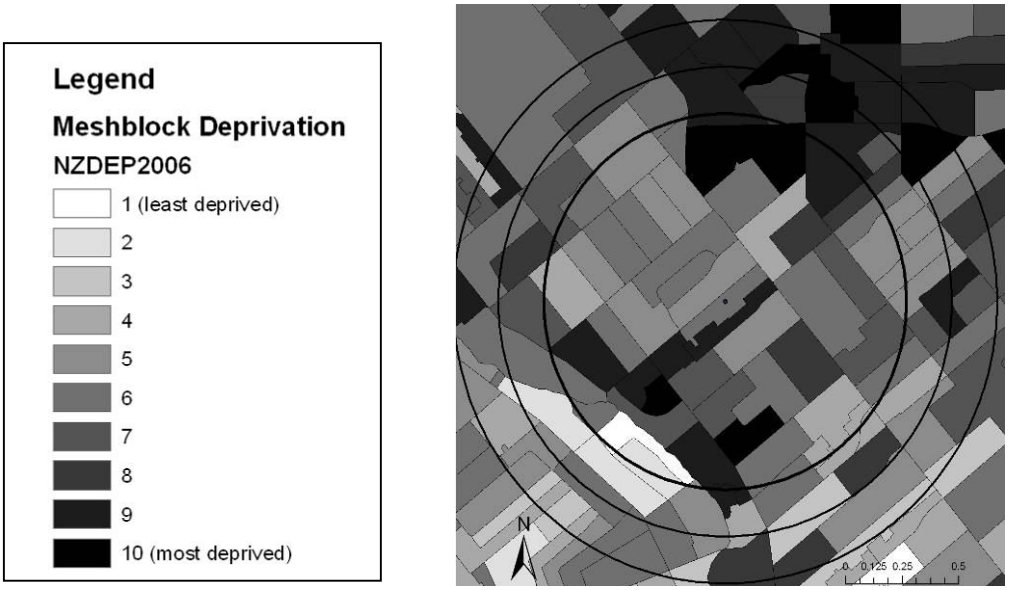


Appendix 2.6: Map of Edgeware neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

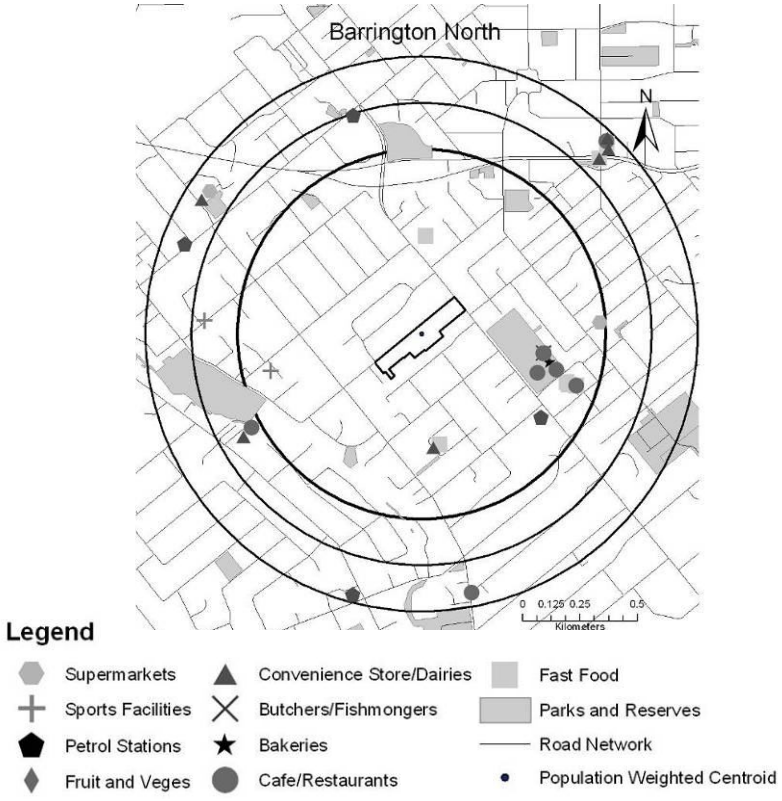
Barrington North (Medium Deprivation)

This neighbourhood is mostly medium deprivation with pockets of high deprivation areas (Appendix 2.7). This is particularly noticeable at the top of the neighbourhood. An interesting point to note is that the busy Southern Motorway is located through the middle of this high deprivation area. While the majority of the neighbourhood is consistent with a medium deprivation neighbourhood, one small pocket of low deprivation is apparent in the lower half of the neighbourhood.

Appendix 2.8 illustrates the local amenities available in the Barrington North neighbourhood. This neighbourhood has access to two sports fields, located at opposite ends of the neighbourhood providing residents and other users with a number of diverse areas for physical activity. The presence of Barrington Mall has created a cluster of food resources within the neighbourhood. While a both a supermarket and local butchery are provided within easy walking distance, the presence of the mall increases the number of fast food facilities through both the provision of a food court and other fast food located outside the mall area. The presences of busy arterial roads connecting to the Southern Motorway decreases the number of facilities in the upper half of the neighbourhood, requiring that residents travel towards Barrington Mall, or out of the neighbourhood area to reach the resources they require. A larger neighbourhood area has the biggest influence on green space, providing at least another three areas for residents to utilize as well as another sport facility. Food resources within this larger area change very little with the majority of these resources such as dairies and petrol stations encouraging unhealthy consumption patterns.



Appendix 2.7: Deprivation profile of the medium deprivation Barrington North neighbourhood

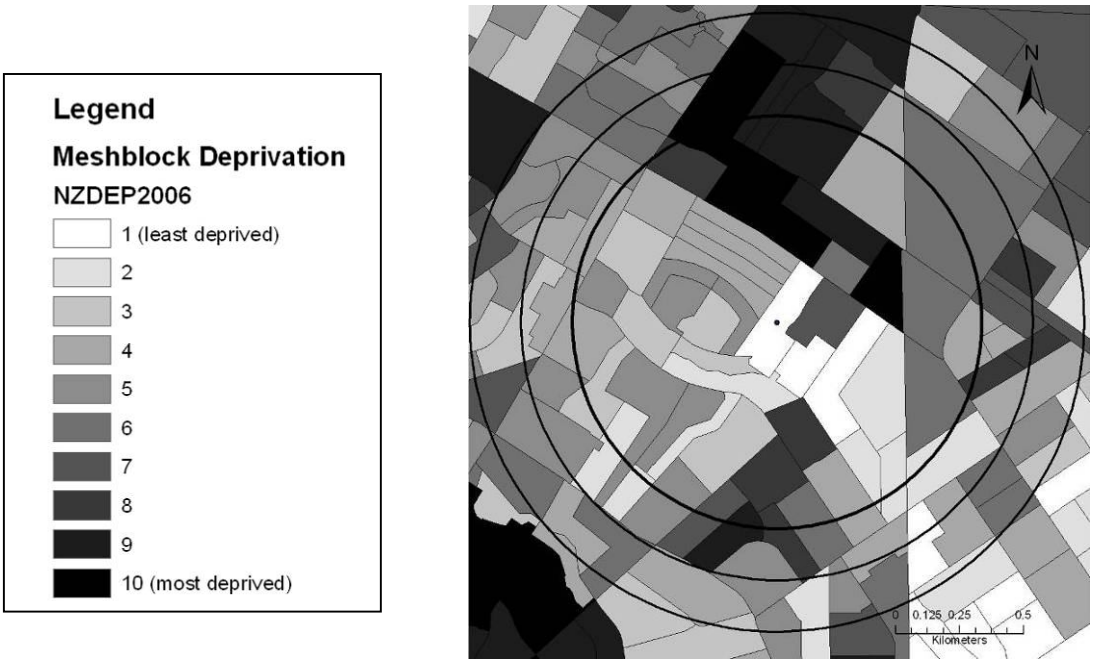


Appendix 2.8: Map of Barrington North neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

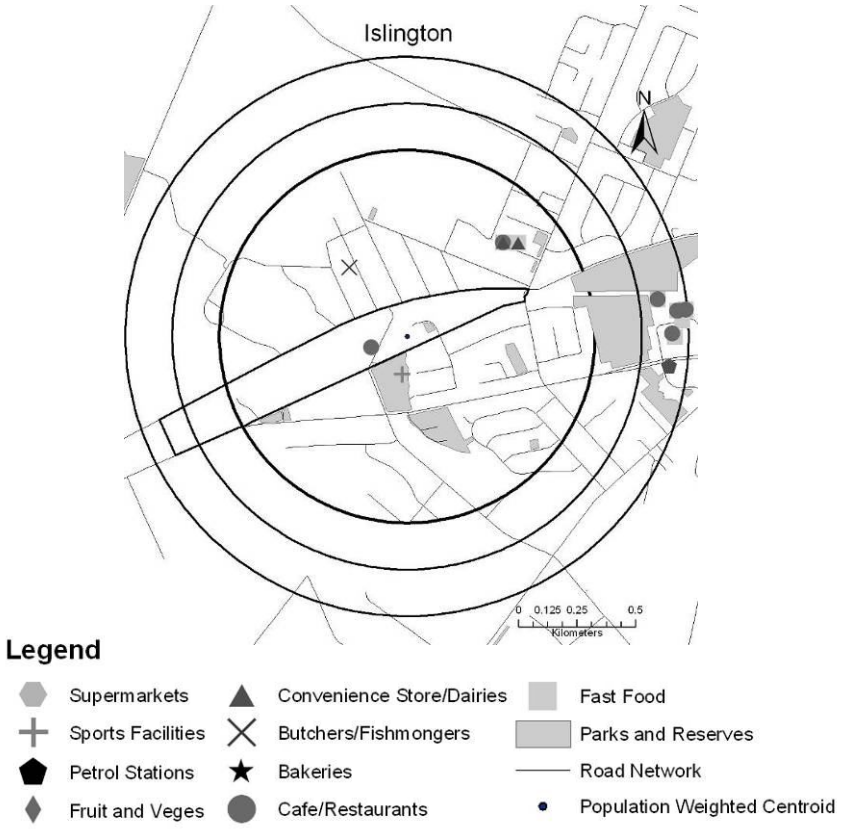
Islington (Medium Deprivation)

The majority of mesh blocks within the neighbourhood of Islington are medium to high deprivation (Figure 4.10). In fact, the lowest deprivation mesh block within this neighbourhood is a deprivation decile three, of which there is only one. The large industrial park located in this neighbourhood is spread over the upper left quadrant of the neighbourhood in an area primarily made up of deprivation six mesh blocks. On the opposite side of the neighbourhood is most deprived portion of the neighbourhood. It is important to note that many of the resources are actually located within this area.

The neighbourhood of Islington is located on the boundary between urban and rural Christchurch demonstrated by the increasing sizes of the meshblocks in the neighbourhood (Appendix 2.9). As the left half of the neighbourhood is largely industrial land use, neighbourhood food resources are largely grouped within one small area. As a result of these two factors, the number of resources available to the neighbourhood decreases and residents must travel towards the city to reach the amenities they need. Areas of green space are distributed fairly evenly around the neighbourhood with residents having access to at least one park within the immediate vicinity. The neighbourhood also provides access to a sports field, bowling green and soccer field, increasing the opportunity for residents to engage in physical activity. The most obvious change when defining a neighbourhood as a larger area is the inclusion of Hornby Mall at the 1.2 kilometre boundary. The presence of this facility can help us understand whether the perceived extent of the neighbourhood varies from the academic definition of a neighbourhood as resident's who believe they have access to Hornby Mall within their neighbourhood will have a larger subjective social space than the literature suggests.



Appendix 2.9: Deprivation profile of the medium deprivation Islington neighbourhood

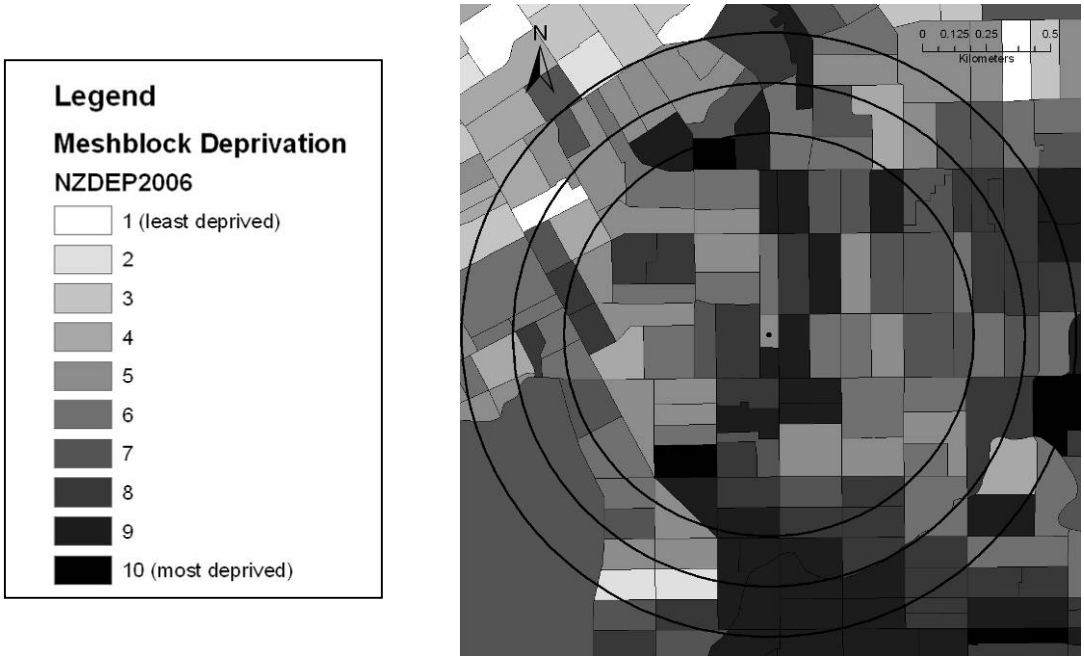


Appendix 2.10: Map of Islington neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

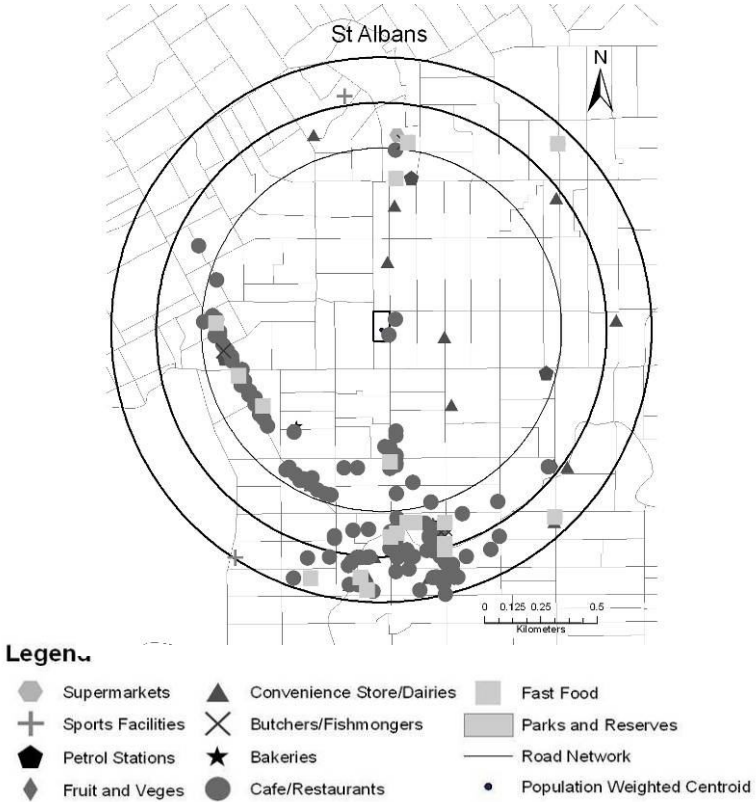
St Albans (Medium Deprivation)

While this neighbourhood is classified as a medium deprivation neighbourhood, it contains a large number of high deprivation mesh blocks within the neighbourhood boundary (Appendix 2.11). When comparing the deprivation profile to the location of resources, it is interesting to note that the large cluster of resources located at the bottom of the neighbourhood boundary are all contained within high deprivation meshblocks. However as this area is so close to the CBD this deprivation profile infers less about the population characteristics than other neighbourhoods as the price of housing is more expensive here than other neighbourhoods of a similar deprivation make up.

As a result of its proximity to this area, this neighbourhood has two purposes (Appendix 2.12). The lower half of the neighbourhood is mostly classed as a commercial area whose main focus is on providing shopping facilities and a number of fast food and restaurant/café facilities for dining. The upper half of the neighbourhood is predominately residential and as a result the type of food resources available differs to that of the lower section. This change is clearly evident as the number of dining facilities decrease in favour of a local convenience store or dairy approximately every 200m. Green space also reflects this within an 800 metre buffer. In the lower half of the neighbourhood, areas of green space are small and inconsistent as their primary function is to provide a small garden where passersby are able to sit and eat lunch. Residential areas of green space are much larger and family focused, providing a number of small playground areas for children to play on while parents supervise. The inclusion of a larger neighbourhood area has the most significant effect of all nine neighbourhoods in regards to both food resources and green space areas, largely a result of the proximity to the CBD.



Appendix 2.11: Deprivation profile of the medium deprivation St Albans neighbourhood



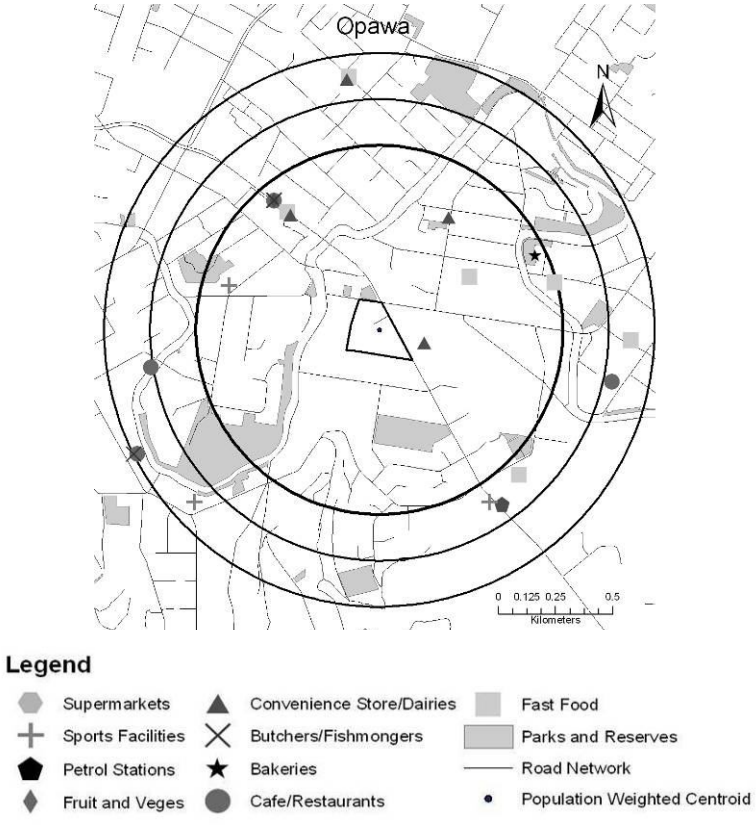
Appendix 2.12: Map of St Albans neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

Opawa (High Deprivation)

While the neighbourhood was originally selected on the basis of containing a high deprivation mesh block, the wider neighbourhood area contains many mesh blocks of lower deprivation (Appendix 2.13). As a result, individual living in this high deprivation mesh block area are exposed to resources more typical of a lower deprivation neighbourhood. The distribution of mesh block variation is separated by a road network with higher deprivation neighbourhoods located north of Brougham Street and lower deprivation mesh blocks to the south. This can have a large influence on the population characteristics of individuals within the neighbourhood area.

Appendix 2.14 illustrates the neighbourhood of Opawa. The provision of a substantial waterway reserve regularly attracts joggers, cyclists and walkers as it provides scenery, wildlife and a safe area to engage in physical activity. Green space is distributed reasonable evenly throughout the neighbourhood providing easy access for all residents. Food resources are limited in the neighbourhood with many residents having to travel to reach even a nearby convenience store. The majority of food resources consist of convenience stores and takeaway outlets with only two restaurants/cafés provided. The presence of an organic butcher does provide the potential for healthier food consumption however as this is a high deprivation neighbourhood; the affordability of the food items may be a deterrent to residents. A larger neighbourhood area creates greater access to a number of food resources, the most important of these being a supermarket within a 1.2 kilometres of residents' homes. While there is a supermarket available, the complexity of the road network within this neighbourhood may increase traveling times to reach such resources and influence the perception of residents in the area.

Appendix 2.13: Deprivation profile of the high deprivation Opawa neighbourhood



Appendix 2.14: Map of St Albans neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

Avonside (High Deprivation)

The Avonside neighbourhood is one of the highest deprivation neighbourhoods of all nine examined for this thesis (Appendix 2.15). The lowest deprivation mesh block within the neighbourhood is a deprivation three, and the highest a deprivation ten category. An obvious split between high deprivation and medium deprivation neighbourhoods occurs in the centre of the neighbourhood with more medium deprivation neighbourhoods located in the north of the boundary area. This can influence the composition of the population within the neighbourhood with lower levels of population mixing.

A large percentage of green space is located outside the 800m neighbourhood buffer. The area provides a sports ground where basketball, rugby, soccer and cricket can be played. Two of these areas also provide an adjoining sports facility, further encouraging physical activity within an individual's own neighbourhood. The presence of a waterway reserve surrounding the Avon River provides an area where individuals can walk and cycle while being sheltered from the busy main roads. Food resources within a smaller neighbourhood area are slim with resident's relying on a small shopping centre and convenience stores. While there is no supermarket available in the neighbourhood, residents do have access to a butcher providing a cheap and healthier alternative to fast food. Using a larger buffered area as the definition of a neighbourhood has an important influence on the food resources within this neighbourhood. Defining the neighbourhood as a 1 kilometre area provides access to a second butchery for residents. Using a larger neighbourhood definition again allows access to a supermarket within 1.2 kilometres of residents' homes. The presence of a supermarket within such a distance is likely to influence a residents' perception of the size of their neighbourhood

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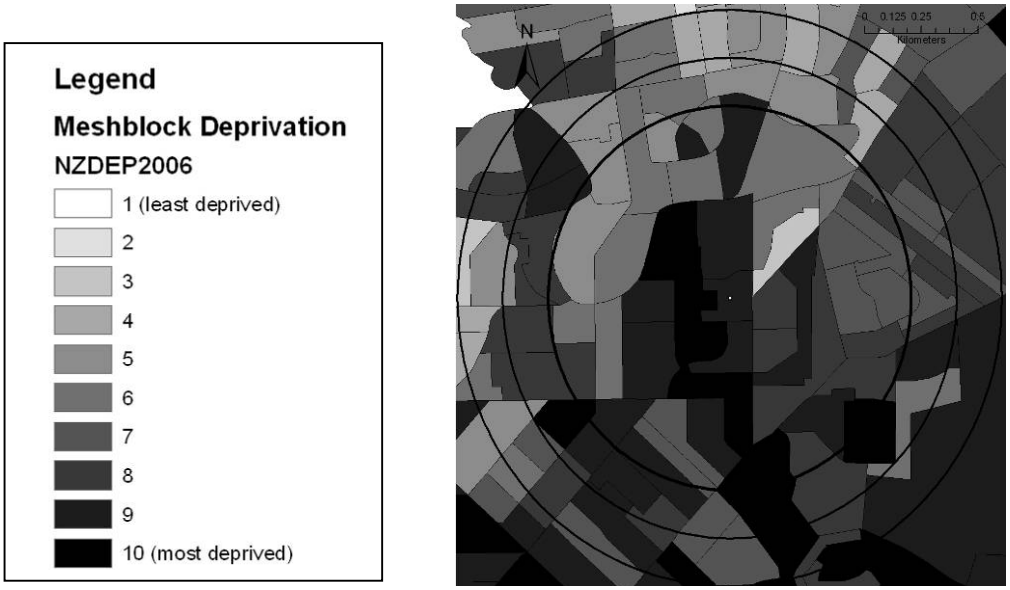
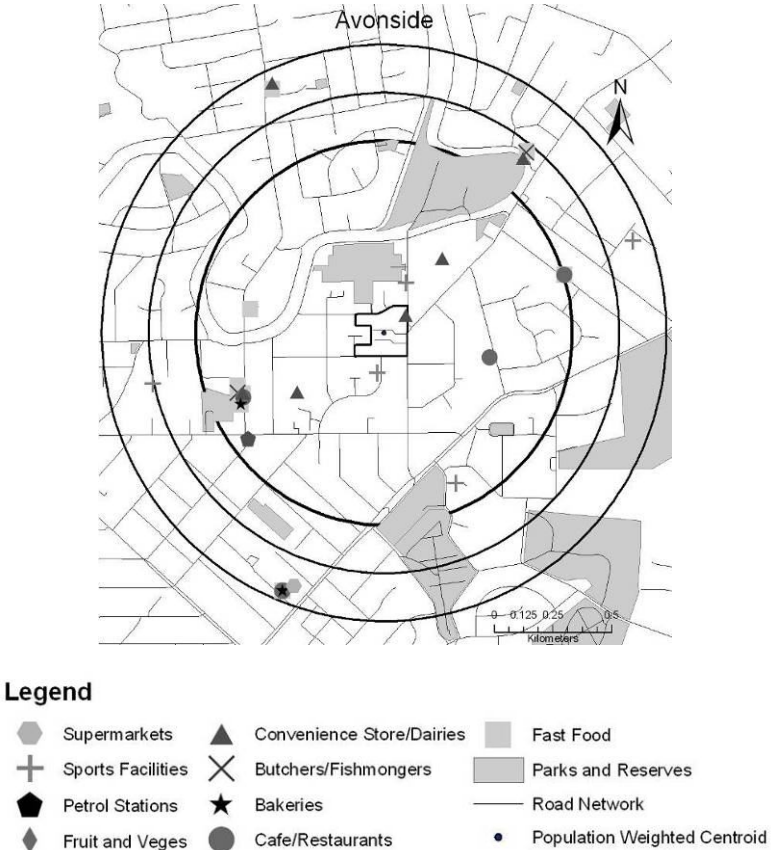


Appendix 2.15: Deprivation profile of the high deprivation Avonside neighbourhood

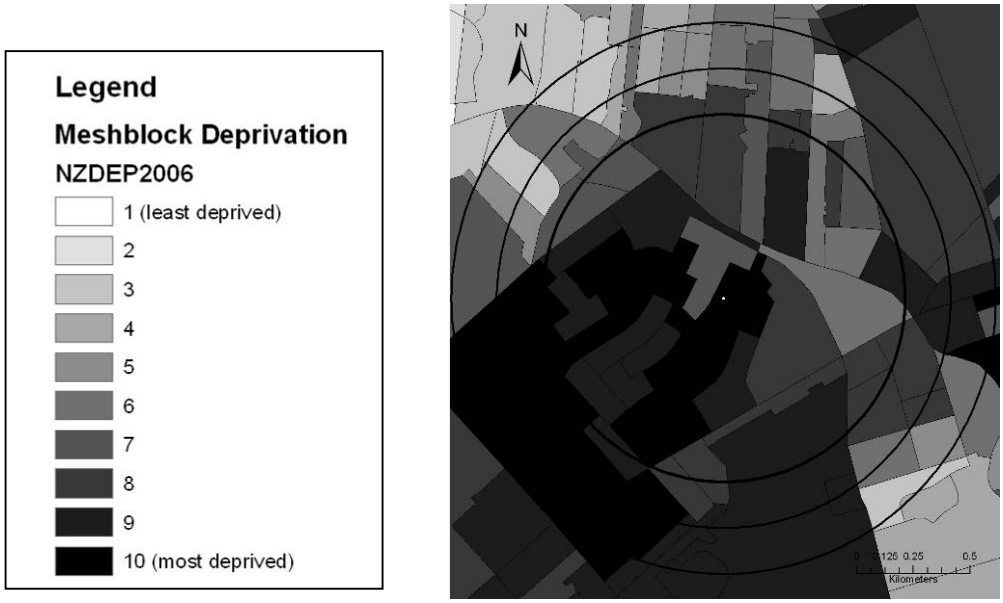


Appendix 2.16: Map of St Albans neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood

4.3.7 Aranui (Deprivation Five)

The Aranui neighbourhood is the highest deprivation neighbourhood examined in this thesis (Appendix 2.17). Mesh block deprivations within this neighbourhood range from medium deprivation six to high deprivation ten. All three of these deprivation six mesh blocks are located on the periphery of the neighbourhood area creating a high deprivation central neighbourhood. Resources within this neighbourhood are most commonly located in the mesh blocks of lower deprivation

This neighbourhood easily has the largest amount of green space available to residents within an 800 metre buffer of all nine neighbourhoods in this study (Appendix 2.18). While a significant portion of this is located outside of the neighbourhood boundaries, residents are still able to access these areas from within their own neighbourhoods. The presence of a large sports field within the neighbourhood that provides facilities for soccer, cricket and rugby encourages participation in physical activity. The majority of food has to be sourced outside the neighbourhood area. The presence of local dairies and fast food outlets may encourage unhealthy food consumption as these facilities are more convenient than traveling to the closest supermarket. While a larger neighbourhood area does provide more food resources for various parts of the neighbourhood, the majority of these promote unhealthy food consumption, requiring that residents still have to travel outside of their neighbourhood area for most healthy food resources.



Appendix 2.17: Deprivation profile of the high deprivation Aranui neighbourhood

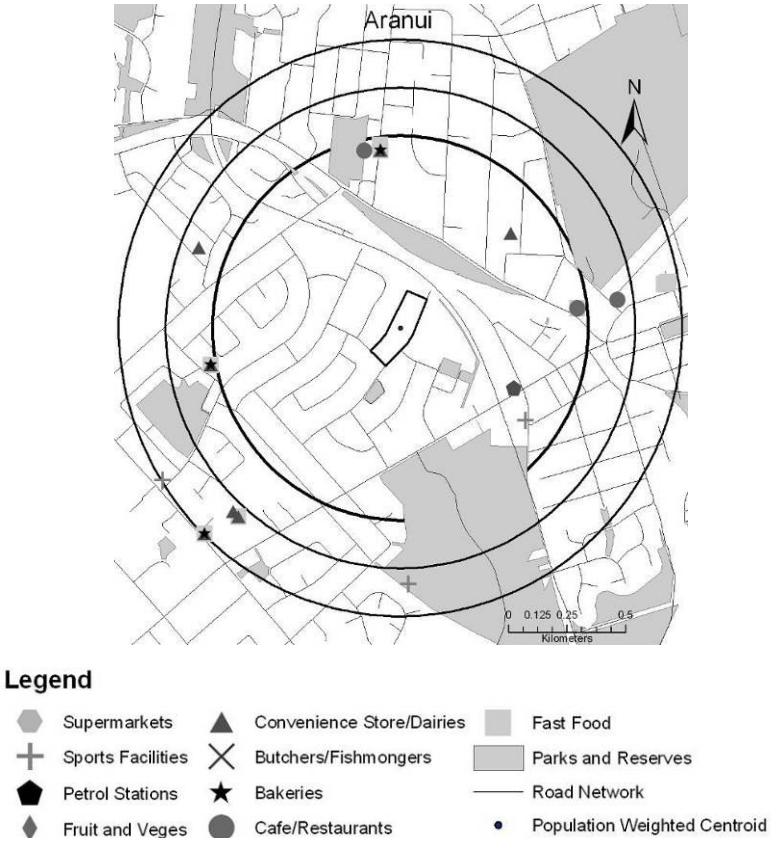


Figure 4.12: Map of Aranui neighbourhood with an 800 metre, 1 kilometre and 1.2 kilometre buffer indicating the spatial placement of local amenities. The highlighted meshblock is the original randomly selected meshblock and the centrepoint of the neighbourhood